

# AGF



CATALOG 607

AMERICAN GAS FURNACE CO.

ELIZABETH, B, NEW JERSEY



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PAUL M. LONG

# Catalog

## No. 607

AMERICAN GAS FURNACE CO.

ELIZABETH - - NEW JERSEY

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AMERICAN GAS FURNACE CO.

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# Questionnaire

In submitting your inquiry your cooperation in giving us the information requested in this questionnaire will be appreciated.

## 1. Process

- a. Hardening
- b. Tempering
- c. Annealing
- d. Normalizing
- e. Carburizing
- f. Nitriding
- g. Ni-Carbing
- h. ....

## 8. Aut. Tem. Control

- a. Make.....
- b. Type.....
- c. Current.....

## 9. Thermocouple

- a. Kind.....
- b. Diameter.....
- c. Location.....

## 2. Work

- a. Size.....
- b. Weight.....

## AVAILABLE

## 10. Fuel, Kind

- a. B.T.U.....
- b. Pressure.....

## 3. Material Type

- a. Steel.....
- b. Brass.....

## 11. Air

- a. Pressure.....
- b. Vol.....

## REQUIRED

## 4. Production

- a. Lbs./hr.....
- b. Operating hr./day

## 12. Elec. AC....DC....

- Volts.....
- Cycles.....
- Phases.....
- No. of wires.....

## 5. Temperature

- a. Max.....
- b. Min.....

## 13. Floor Space

.....

## 6. Heating Time

- a. To Heat.....
- b. Soak.....

## 14. Labor

Type...\$.... /hr.

## 7. Quench

- a. Oil..... Water..

## 15. Present Method

- a. Cost.....
- b. Details in report...

## 16. Proposed Method

.....





## Foreword

**F**OUNDED in 1878, the American Gas Furnace Company conceived and manufactured the first air-gas-fired\* heating appliances. Today, we continue to supply modern equipment for using gas in the heating processes and present in this catalog a complete line of furnaces and burners; equipment that not only performs the heating operations required of it but in addition does it in the shortest possible time with the minimum of gas. As a result considerable saving in time, money and labor is possible.

The following pages briefly tell the story of the many products manufactured. It is hoped that they will assist you in selecting equipment which will more efficiently serve your present needs and which may be best adapted to your new requirements as they arise. A. G. F. engineers stand ready to give you the benefit of their experience at all times.

P. C. OSTERMAN  
President

*\*The principle (using air under positive pressure to entrain the gas) upon which to this day the overwhelming majority of all gas-fired industrial furnaces are operated.*



THIS catalog brings to your attention only standardized burners, furnaces, and heating machines.

It has not been possible to include the many special designs which we have built in more than 80 years of service to industry; therefore may we suggest that you consult us before deciding on new equipment. One of the specials may be better adapted to your needs than a standard.

Our engineers and years of experience are at your service.

YOUR A.G.F. REPRESENTATIVE IS:



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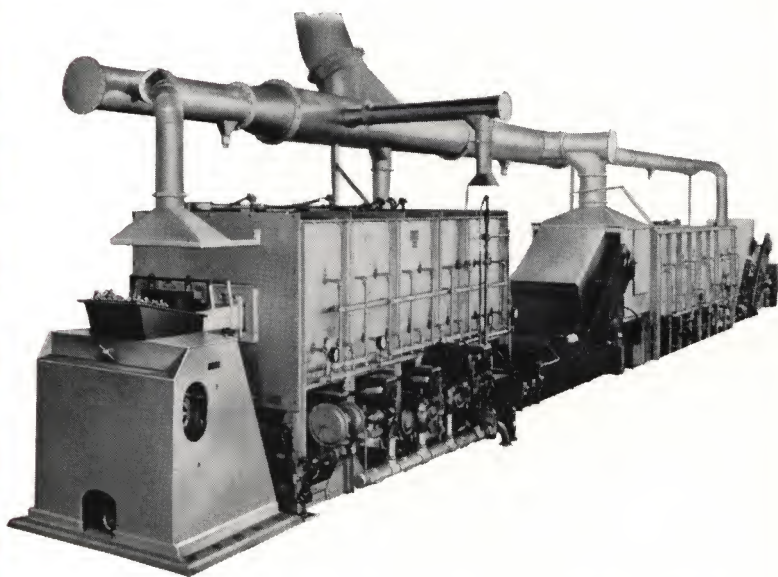
Reciprocating Hearth Furnaces

Continuous Rotary Furnaces

Mesh Belt Conveyor Furnaces

Chain Belt Conveyor Furnaces

Flame Hardening and Heating Machines



An automatic production line for heat treating comprising a Model 240 Reciprocating Furnace, Automatic Quenching Tank, modified Series 300 Conveyor Furnace arranged for tempering and a Conveyorized Quenching Tank.

CYLINDRICAL  
FURNACES

CONTINUOUS  
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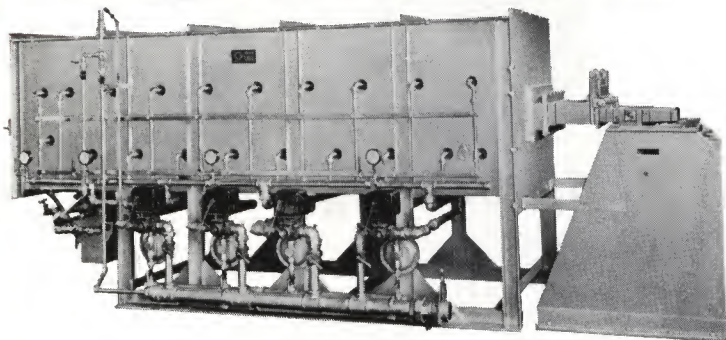
AMMONIA  
DISSOCIATORS







## Improved Series 200 Controlled Atmosphere Reciprocating Furnaces



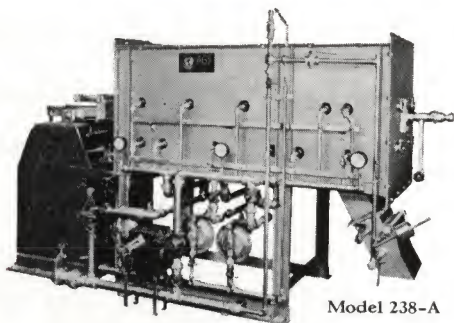
Model 240

**R**ECIPROCATING Hearth Furnaces or "Shaker Hearth Furnaces" were originated and introduced by the American Gas Furnace Company in 1921. The basic principle of operation consists of imparting a forward movement to the work conveying hearth and the work pieces resting on it. This forward movement of the hearth and work is interrupted suddenly, causing the work pieces to advance along the hearth by their own momentum. A simple mechanical drive repeats this movement at the desired rate.

Any desired processing atmosphere and cycle time can be easily maintained in the new style A.G.F. Reciprocating Furnaces. Even the lightest and most delicate work can be handled without distortion.

The improved Series 200 Reciprocating Hearth Furnaces incorporate a stationary fully sealed muffle in which a relatively light hearth is reciprocated on freefloating rollers. The construction of the latest style Reciprocating Furnaces incorporates many new engineering features and refinements which provide many advantages over previous models, including:

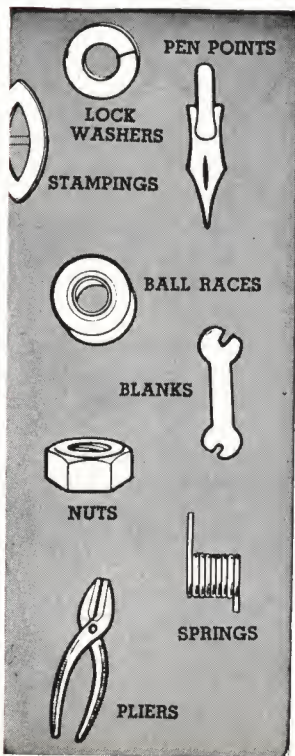
- The ability to remove the work conveying hearth for inspection, for cleaning its surface or for minor maintenance.
- Elimination of physical stresses resulting from muffle reciprocation.



Model 238-A

## Reciprocating Furnaces

- Alloy life is increased. The muffle floor is not quenched by cold work, thus eliminating the possibility of thermal stressing. The hearth is also supported above the muffle floor on free floating rollers to eliminate conductive heating. The parts traveling along the work conveying hearth are heated by radiation from all of the surrounding muffle surfaces.



- Quieter operation is achieved because only a relatively light hearth is reciprocated back and forth.
- Shorter processing cycles can be more easily maintained in larger size models.

### OPERATIONAL ADVANTAGES

#### Uniform and Individualized Treatment.

Each work piece is uniformly heated in a controlled atmosphere within the muffle during all stages of the processing cycle. Each piece receives its own individualized quench as the work parts continuously trickle off the work conveying hearth, dropping singly into the quench.

#### Versatility.

A.G.F. Reciprocating Furnaces can be used without any modification





whatsoever for various types of general and atmosphere work such as carburizing, case hardening, the "Ni-Carb" process of ammonia-gas carburizing, bright hardening, etc. Parts ranging from balls for ball point pens up to heavy forgings can be processed in the same model. Processing time cycle is completely adjustable.

### Flexibility.

Production heat treating departments can handle small as well as large production lots on a continuous basis. Large production runs can be easily interrupted to permit processing small batches which are more urgently required.

### Positive Atmosphere Control.

Construction enables positive atmosphere control of the desired atmosphere within the muffle through all stages of the processing cycle. The new Series 200 Reciprocating Furnaces can be equipped with special provisions for handling hydrogen or cracked ammonia atmosphere for heat treating stainless steels.

### Thermal Efficiency.

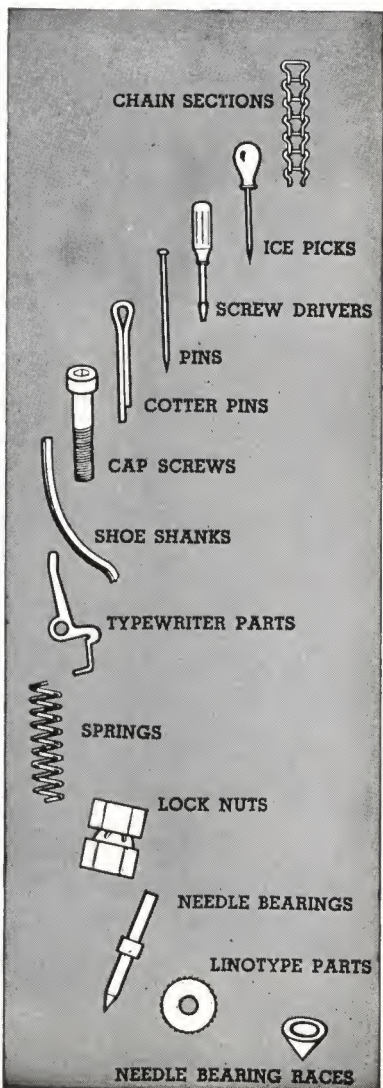
Only the work enters and leaves the heating chamber. There is no belt or conveyor to remove heat and waste fuel.

### Simplicity.

A. G. F. Reciprocating Furnaces have no wearing parts in the heat, making maintenance easy and uncomplicated.

### Reduced Handling Costs.

Automatic feeders can be supplied to eliminate costly work handling in charging the furnace. These





new feeders will handle a majority of the parts normally handled in production heat treating. If unusually shaped pieces are to be processed, the portable feeder can be easily moved to one side to permit manual feeding.

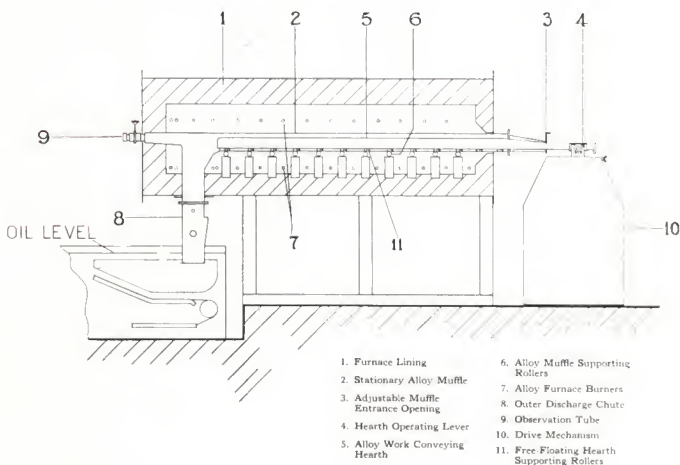
### Capacities.

A.G.F. Series 200 Reciprocating Furnaces are available in various sizes having production capacities up to 800 pounds per hour, see tabulation on page 9. The actual production rate depends on the weight of the parts relative to their bulk, the cross section of the parts and the desired processing time cycle.

### Construction Features.

A.G.F. Reciprocating Furnaces are engineered and built to withstand the severe and continuous service to which these furnaces are subjected in production heat treating departments and commercial heat treating plants.

## Reciprocating Hearth Furnace Cross Sectional Diagram





## GENERAL CONSTRUCTION

### Stationary Alloy Muffle.

The stationary alloy muffle completely encloses the work conveying hearth. The discharge throat of the muffle has a 100% atmosphere seal. The muffle entrance is adjustable to suit the work pieces, thus more positively containing the atmosphere within the muffle.

A piloted type fume eductor is provided for the discharge throat of the muffle to exhaust any quenching medium vapors and to ignite them if they are flammable.

The muffle is cast of the best available heat-resisting alloy, composition 60% nickel, 12% chromium, to withstand operation at temperatures up to 1850°F. Numerous heat-resisting alloy bars are employed to uniformly support the muffle on the refractory piers throughout its heated length.

### Easily Removable Alloy Hearth.

Removal of the work conveying hearth is easily accomplished, thus facilitating cleaning and inspection.

The hearth is supplied of the best available high grade heat-resisting alloy, composition 60% nickel, 12% chromium or better, and is supported within the muffle on free floating alloy rollers.

To insure smooth flow of work pieces the hearth is made in one piece. For long thin pieces, the work conveying hearth is grooved longitudinally to insure that such parts travel with their long axis parallel with the length of the hearth. For balls or other work wherever it is necessary, transverse grooves can be supplied.

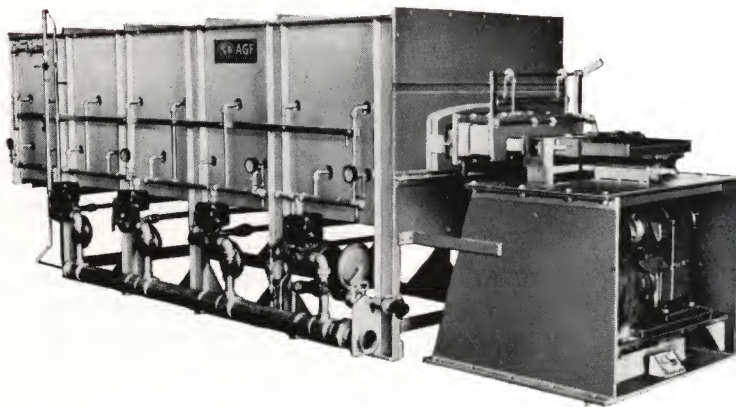
### Simple, Trouble-Free Mechanical Drive.

The rugged and uncomplicated drive mechanism comprises a cam driven by a Reeves variable speed transmission, actuating a spring loaded lever which drives the work conveying hearth. Drive maintenance problems are eliminated.





## Reciprocating Furnaces



Model 260

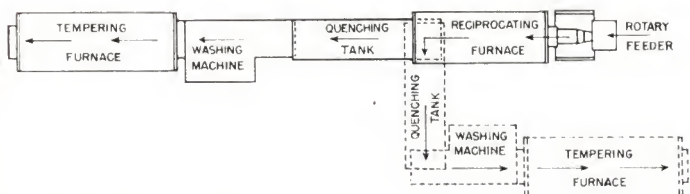
### High Quality, High Efficiency Lining.

The lining comprises  $4\frac{1}{2}$ " of high grade insulating refractory backed up with block insulation. Low heat storage and low heat loss provides faster heating-up and more economical operation.

### Combustion System.

The new Series 200 Reciprocating Furnaces are equipped with multi-zone combustion systems designed to achieve extremely uniform and rapid heating of the muffle. Maximum temperature uniformity is assured by the use of many burners firing into both sides of the amply sized combustion chamber, both above and below the muffle.

Each burner has a relatively small heat input and is sized according to its location on the furnace to obtain uniform heat distribution and temperature. Alloy burners and super refractory burner tunnels are employed for long life with freedom from repairs.



Solid line shows an "in-line" installation; dotted line shows a "reversing loop."

## Casing.

The furnace casing is constructed of welded steel plate suitably reinforced with structural members welded and bolted together. The drive mechanism is mounted in a separate extension apart from the heating chamber.

A special foundation is not required except for anchoring the drive mechanism extension.

## Outer Discharge Chute.

The discharge chute is mounted directly on to the discharge throat of the stationary muffle. For special applications, the muffle throat can be equipped with a diverter type discharge chute extension for dual quenching arrangements, etc.

## PROCESSING TIME CYCLE REGULATION

Control of the processing time cycle is easily accomplished by adjustment of the variable speed motor drive. Where extremely long processing time cycles are required, the Series 200 Reciprocating Furnaces can be equipped with an interrupter type timer at a slight additional charge.

## F. M. SAFETY REQUIREMENTS

Series 200 Reciprocating Furnaces can be equipped with the necessary extra devices to comply with Factory Mutual requirements at a slight additional charge.



## ATMOSPHERE GAS CONTROL

A.G.F. Atmosphere Gas Mixing Cabinets as illustrated on page 167 are employed to enable the measurement and control of the flow of the atmosphere gases that are to be introduced into the muffle of the furnace.

## ATMOSPHERE GAS GENERATORS

Where a supply of atmosphere gas is not available, a suitable endothermic or charcoal gas generator can be furnished. For the processing of stainless steels, a dissociator can be supplied to furnish cracked ammonia atmosphere.

## AUTOMATIC QUENCHING TANKS

Complete automatic Quenching Tanks as per pages 35-40, having a variable speed motor drive, recirculating pump, etc. are supplied for use with Series 200 Reciprocating Furnaces. A.G.F. Quenching Tanks can be supplied for oil, water or brine quenching.

A.G.F. Quenching Tanks are designed for installation "in line" or at "right angle" to the Reciprocating Furnace.

## AUTOMATIC WASHING AND TEMPERING EQUIPMENT

Automatic washing and tempering equipment can be supplied for use in conjunction with A.G.F. Series 200 Reciprocating Furnaces and Automatic Quenching Tanks.

The installation lends itself to either an "in-line" or "reversing loop" arrangement as illustrated on page 7.

Note that the "reversing loop" installation permits discharging the processed work immediately adjacent to the charging end of the Reciprocating Furnace. The center aisle of the "reversing loop" provides easy access to all equipment for maintenance as well as providing space for installing accessory equipment.



# Specifications

Reciprocating Furnace No.	Capacity, approx. lbs. per hour	Hearth			Operating Data				Supply Connections Pipe Size			Floor Space	Net Weight, Lbs.	Shipping Weight, Lbs.	Approximate Shipping Measure
		Width, Approx.	Available Height	Available Heated Length	Max. Air Req. Cu. Ft./Min. at 1 lb./sq. in.	Max. Gas Consumption		Muffle Atmosphere Gas Required Cu. Ft./Hr.	Air	Gas	Muffle Atmosphere				
						1050 B.T.U. Nat. Gas Cu. Ft./Hr.	B.T.U./Hr.								
238-A	150	12"	3 3/8"	48"	63	382	402,700	Approx. 150*	2"	1"	3/4"	54"x126"	6,200	7,000	54"x66"x90" 40"x54"x48"
230-E	225	12"	3 1/4"	78"	85	500	525,000	Approx. 250*	2"	1 1/2"	1"	55"x146"	8,000	8,876	55"x75"x143" 48"x55"x36"
240-D	450	18"	4"	110"	135	725	761,250	Approx. 375*	3"	1 1/2"	1 1/4"	70"x186"	12,000	13,000	67"x80"x156" 52"x52"x48"
250	450	24"	3 1/4"	78"	135	725	761,250	Approx. 425*	3"	1 1/2"	1 1/4"	73"x150"	13,500	14,500	73"x75"x143" 56"x52"x36"
†250-C	450	24"	4 1/2"	78"	135	725	761,250	Approx. 425*	3"	1 1/2"	1 1/4"	73"x150"	14,250	15,250	73"x77"x143" 56"x52"x36"
260	800	24"	3 1/2"	144"	188	1,090	1,141,350	Approx. 475*	3"	2"	1 1/2"	73"x217"	27,000	28,500	73"x75"x210" 56"x52"x36"

†Special model for large volume of small parts or extra high work. Features include larger domed muffle with increased heating chamber and center dividing rib on hearth when used for small parts.

\*Atmosphere gas requirement listed is for an endothermic type. If fuel gas is used requirement would be decreased.

AMMONIA  
DISSOCIATORS

BELL RETORT  
FURNACES

TUBE  
FURNACES

MUFFLE  
FURNACES

BATCH TYPE  
RETORT  
FURNACES

AUTOMATIC  
QUENCH TANKS  
FURNACES

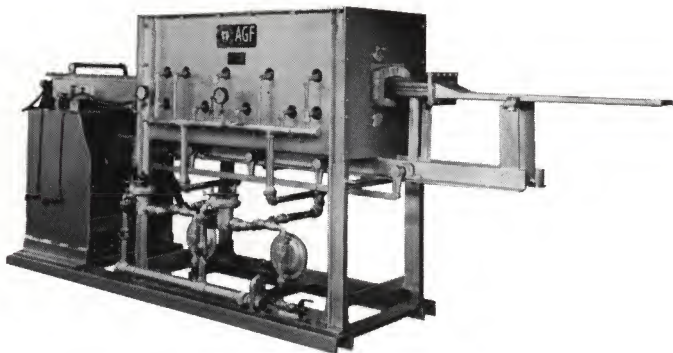
OVEN  
FURNACES

CYLINDRICAL  
FURNACES



## Reciprocating Furnace

for Bright Annealing and  
Hardening of Stainless Parts



Model 267—heated muffle hearth 7½" wide by 52" long.

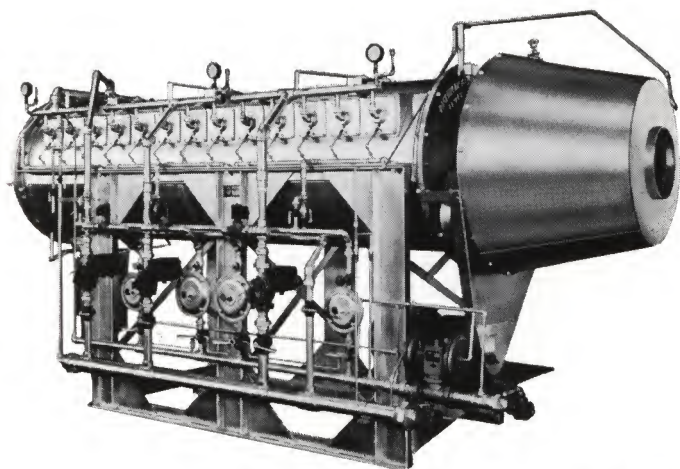
**T**HE Model 267 Reciprocating Furnace has a capacity of up to 80 lbs. of stainless steel parts per hour, operating at temperatures up to 2000°F.

An alloy muffle . . . incorporating purging, heating and water-jacketed cooling sections . . . seals into an automatic conveyorized oil tank and permits maintenance of hydrogen or dissociated ammonia atmosphere with dew-points as low as minus 80° to minus 90°F.

The full seal construction of the muffle insures complete atmosphere uniformity throughout the entire processing cycle and lowers the required consumption of atmosphere gas.

Parts travel, individually, through the entire processing cycle and are under observation at all times.

Eliminates the inherent disadvantages of batch purging, heating and cooling . . . Guess work and timing by the operator is completely eliminated.



Model 139-MD

## Controlled Atmosphere Continuous Rotary Retort Furnaces

A.G.F.'s new line of Controlled Atmosphere Continuous Rotary Retort Furnaces retains all of the sound and time proven basic principles of operation and construction originally introduced by the American Gas Furnace Company in the first Rotary Retort Furnaces manufactured in 1896.

These latest style furnaces incorporate many new improvements and refinements which increase their production capacity, permit more exacting control of processing atmosphere and temperature, and simplify operating procedure.

A completely new combustion system and other engineering features permit processing ferrous or non-ferrous parts at temperatures from 600°F. to 1850°F. Clean hardening, ammonia-gas case hardening, light case carburizing of steel parts or the heat treating of aluminum parts can be accomplished with equal ease and without any modification of the furnace.

The improved versatility of the A.G.F. Continuous Rotary Furnaces make them the ideal production units for the heat treating department of small parts manufacturers or for use by commercial heat treaters.

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MUFFLE  
FURNACES  
TUBE  
FURNACES  
BELL RETORT  
FURNACES  
AMMONIA  
DISSOCIATORS





## Continuous Rotary Retort Furnaces

For heat treating parts which can be subjected to a gentle tumbling action in the order of 1 or 2 r.p.m., the new A.G.F. Continuous Rotary Retort Furnace affords economies of operation which permit heat treating at the lowest possible cost.

### OPERATIONAL ADVANTAGES

#### Automatic Feeding for Low-Cost Continuous Operation

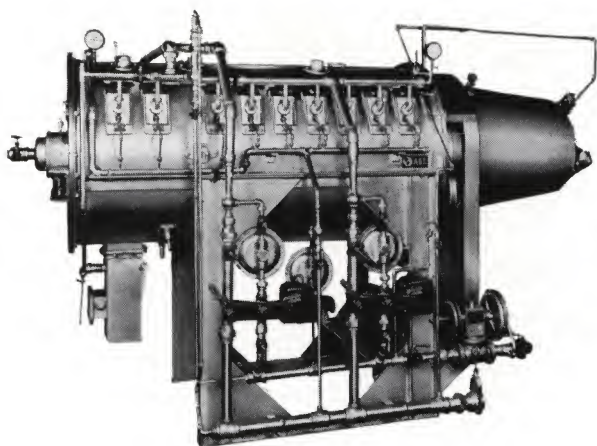
A.G.F. Continuous Rotary Retort Furnaces are equipped with an improved large capacity feed hopper having an adjustable self-metering arrangement which permits preloading of work for continuous feeding. New door mechanism on the hopper reduces work loading time to a minimum.

#### Uniform Processing of the Work is Assured.

The new Continuous Rotary Retort Furnaces eliminate the disadvantages of batch heat treatment and batch quenching. Retort rotation mixes the work, uniformly heating and exposing each piece to the controlled atmosphere within the retort. Each work piece receives an individual quench as it drops into the quenching medium.

#### Flexibility.

These improved Controlled Atmosphere Continuous Rotary Retort Furnaces can be used without any modification whatsoever for various types of general and atmosphere work at processing temperatures from 600°F. to 1850°F. Steel parts can be carburized, case hardened, "Ni-Carbed" or clean hardened. Aluminum and other non-ferrous metals can be heat treated under atmosphere control at any desired temperature. Processing time cycle is easily controlled by means of a variable speed motor drive. Normal processing times available range from 3 to 4 minutes to upwards of an hour. Special drive arrangements can be supplied to achieve longer time cycles required for deep casing or carburizing. The same model will accommodate parts ranging in size from small washers to forgings for universal joints, etc.



Model 136-MG

## Reduced Maintenance and Operating Costs.

Alloy parts remain within the heating chamber at all times, thus eliminating the principal cause of alloy failure—repeated heating and cooling.

Work only enters and leaves the furnace heating chamber. There are no baskets or trays to carry heat out of the furnace or to require maintenance.

All moving mechanical parts on A.G.F. Continuous Rotary Retort Furnaces are located outside of the hot areas of the furnace. There are no chains, conveyors or other troublesome mechanisms employed in the furnace heating chamber.

## PRINCIPLE OF OPERATION

The work parts are charged into an automatic hopper feeding device which continuously feeds them into the retort. The retort which is rotated within a heating chamber has an integral internal spiral which advances the work through the heat.

The parts leaving the retort fall through a unique sealing hood assembly located within the heating chamber and into the quench.

The feed hopper and sealing hood assembly are designed and constructed to enable practically positive control of the desired atmosphere within the retort through all stages of the processing cycle.



## Continuous Rotary Retort Furnaces

### CAPACITY

The capacity of each furnace is dependent to a considerable extent upon the individual user, the cross section of the parts, the weight of the parts relative to their bulk, and the processing time cycle. The range of production capacity of various models is from 150 to 1500 pounds per hour.

### CONSTRUCTION

New construction features and design modifications have been incorporated in the latest model Controlled Atmosphere Rotary Furnaces to provide greater ease of operation, increased production, less maintenance and longer alloy life.

Principal construction features are shown in the cross sectional diagram on page 16 and include:

#### Heavy-Wall Alloy Retort.

The retort with integral spiral is cast of heat-resisting alloy, composition 60% nickel, 12% chromium, to withstand operation at temperatures up to 1850°F.

#### Alloy Sealing Hood.

This assembly cast of alloy, composition 60% nickel, 12% chromium, is employed within the heating chamber to permit quenching of the work from retort at the proper temperature and under atmosphere protection.

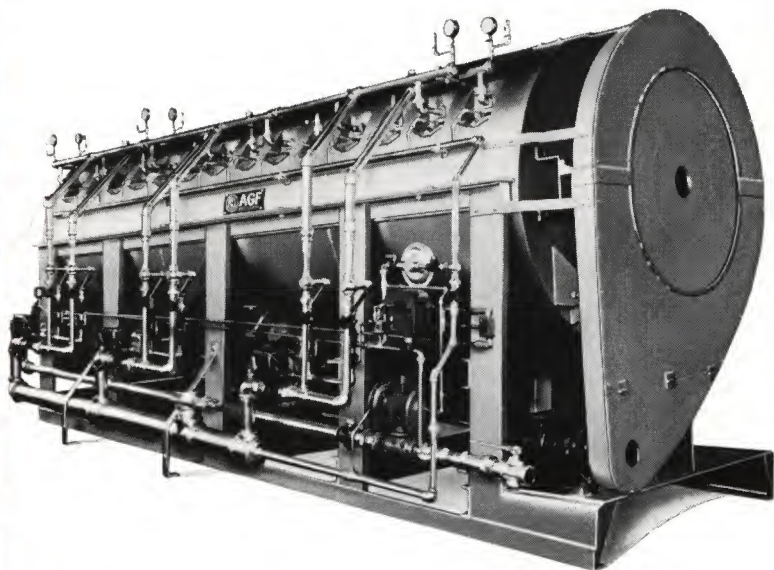
#### High Quality, High Efficiency Lining.

The lining consists of highest grade insulating refractory backed by block insulation. This type of construction has low heat storage and low heat loss factors and is employed to achieve faster heating up and more economical operation.

#### Improved Gas Combustion System Features include:

Numerous heat-resisting alloy burners firing tangentially into the heating chamber through super refractory burner tunnels





Model 227 Continuous Rotary Retort Furnace. Feeding hopper similar to those for Model 136-MG and 139-MD can be supplied.

are equipped with individual pilots for ease in lighting and safe positive operation.

A.G.F. Continuous Rotary Retort Furnaces are furnished with multi-zone control of the processing temperature. Two zone control is regularly employed in the Model 136-MG and three zones of control are employed in the Model 139-MD. The Model 227 can be furnished with either three or four zone control.

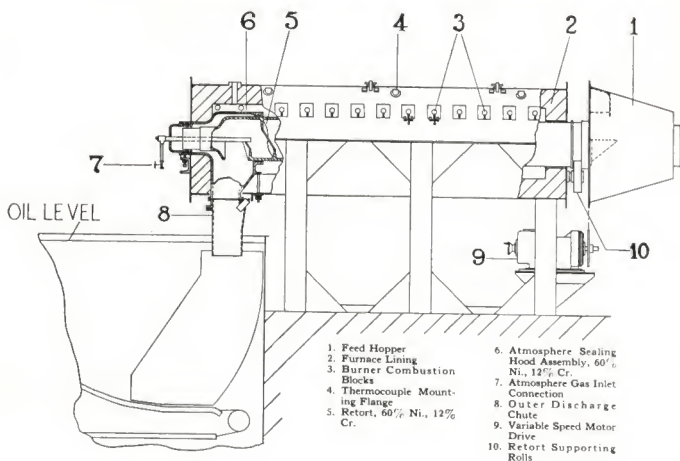
### Casing.

The furnace body is constructed of heavy sheet steel suitably reinforced. The structural steel leg assembly is designed to properly accommodate a standard A.G.F. Automatic Quenching Tank as described on pages 35-40.

### Feed Hopper.

The assembly is fabricated of heavy sheet steel and is equipped with an inner scoop which delivers a metered amount of work pieces into the retort. The capacity of the scoop can be adjusted by means of an external hand wheel. The hopper opening is equipped with an easily operated cover device.

## Continuous Rotary Retort Furnaces Cross Sectional Diagram



### Retort Supporting Rolls and Bearings.

Designed and built to minimize maintenance. Charge end supporting rolls are cast with wide chilled faces and are equipped with copper-graphite bearings for trouble-free operation. A new simplified roller type bearing assembly located outside of the heat supports the discharge end of the retort.

### Outer Discharge Chute.

The work discharge chute is equipped with a piloted type fume eductor to remove quenching medium vapors and to ignite them if they are flammable.

### Atmosphere Gas Inlet.

A suitable provision for the introduction of atmosphere gas is made at the discharge end of the retort. This connection is gas tight and stationary, eliminating the use of a stuffing box or swing joint.

### Variable Speed Motor Drive.

The drive mechanism comprises a standard enclosed variable speed transmission and worm gear reducer selected to provide the proper speed range to suit the type of work and the processing cycle times that will be employed.

The motor drive assembly is mounted on an easily accessible plate in the bottom of the furnace leg frame. All exposed moving parts are protected by safety guards.



## Controlled Atmosphere Continuous Rotary Retort Furnaces

Rotary Retort Furnace No.	Capacity, lbs./hr. of steel heated to 1500°F.	Retort				Operating Data			
		Inside Diameter	Available Length	Spiral Path		Max. Gas Consumption	Retort Atmosphere Gas Required Cu. Ft./Hr.		
				Available Width	Height				
136-MG	150 to 400	10"	5'-0"	5" 6½"	2½" 2½"	65	373	392,400	Approx. 200*
139-MD	400 to 900	14"	10'-0"	6¼" 8"	4½" 4½"	150	865	911,000	Approx. 275*
227-D	1200 to 2000	24"	14'-0"	11"	4½"	383	2,300	2,315,000	Approx. 650*

\*Atmosphere gas requirement listed is for an endothermic type. If fuel gas is used, requirement would be decreased.

### FUEL

Fuel can be either manufactured gas, reformed natural gas, natural gas or the bottled gases propane and butane. Required gas pressure is 2" to 6" water column. Furnaces can be specially equipped for operation with oil.

### F. M. SAFETY REQUIREMENTS

A.G.F. Controlled Atmosphere Continuous Rotary Retort Furnaces can be equipped with the necessary devices to comply with Factory Mutual requirements at a slight additional charge.

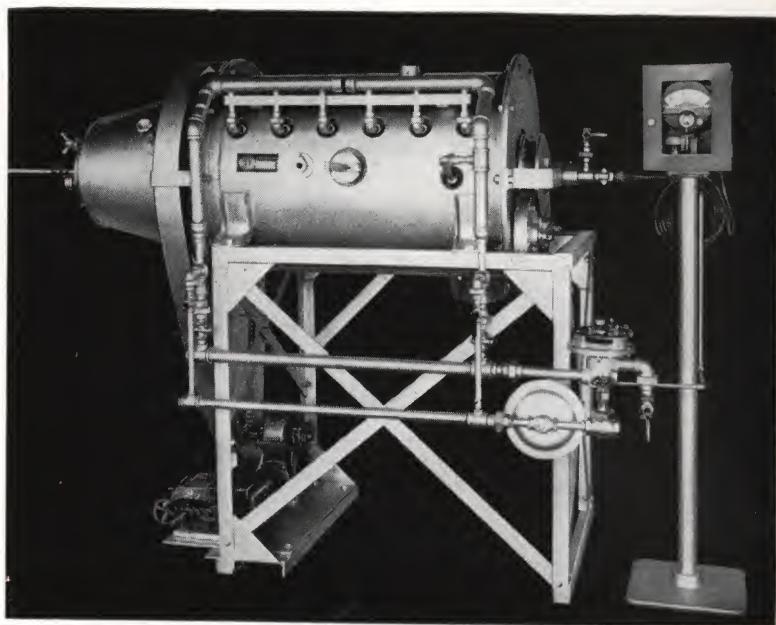
### AUTOMATIC QUENCHING

A.G.F. Automatic Quenching Tanks for use with oil or water as described on pages 35-40 are supplied.





## Continuous Rotary Retort Furnace (Semi-Controlled Atmosphere Type) Model No. 29-F—Internal Discharge



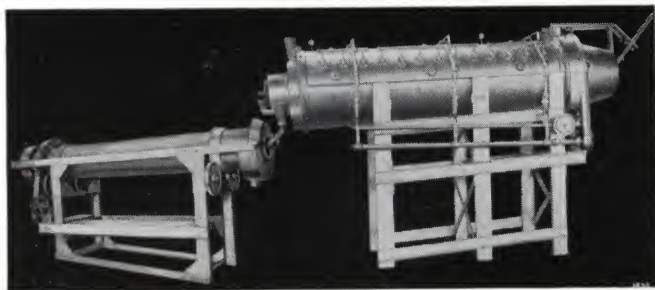
The Model No. 29-F, although similar in general construction to the furnaces described on pages 11-17 does not employ the elaborate construction which insures the positive atmosphere control offered in Models 136-MG and 139-MD.

By setting the air-gas fuel mixture in the proper ratio, a protective type atmosphere is generated which is forced out through the retort opening. The results produced by this economical furnace make it suitable for the relatively clean hardening of some parts.

Furnace No.	Capacity lbs. of steel heated to 1500°F.	Inside Diameter of Retort	Available Length in Retort	Spiral		Max. Gas Cons. (1050 B.T.U.) (cu. ft./hr.)	Gas required for holding 1550°F. (cu. ft./hr.)	Max. Air Required cu. ft./min. at 16 oz.
				Width	Height			
29-F	75 to 100	7½"	30"	3¼"	2"	138	25	25



## Continuous Rotary Retort Annealing Furnaces



**T**HE A.G.F. Rotary Retort Furnaces described on pages 11-18 can be equipped with an external discharge arrangement as shown in the above illustration.

The work can be discharged at temperature or passed into a directly connected water jacketed cooling extension.

### PRINCIPLE OF OPERATION

A.G.F. Rotary Annealing Furnaces are equipped with the latest style improved combustion system which permits annealing of ferrous and non-ferrous parts at temperatures from 600°F. to 1800°F.

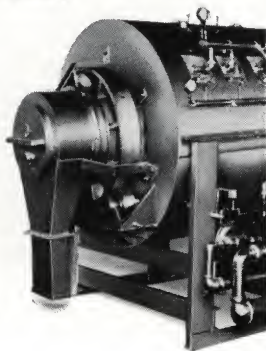
All of the advantageous features including the automatic feeding hopper, heavy wall alloy retort, efficient lining, multiple zone construction are incorporated in these units.

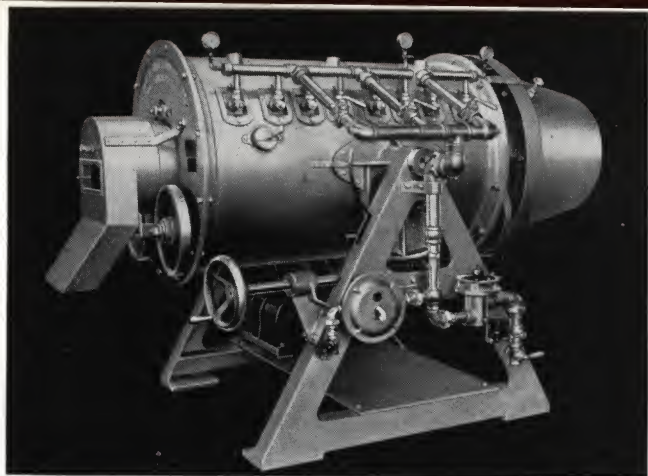
For special applications these furnaces can be equipped with smooth retorts. The slope or inclination of the retort which controls the length of the heating cycle can be varied by elevating the rigidly constructed furnace frame at one end. Where direct connected cooling extensions are employed, the heating furnace and cooler are mounted on common structural members so that the slope or inclination of both may be adjusted simultaneously.

## Continuous Rotary Calcining and Roasting Furnaces

A.G.F. Rotary Retort Furnaces as described on pages 11-18 can be supplied with the external type discharge as illustrated. The calcined or roasted materials can be either discharged at temperature or slow cooled in a directly coupled water jacketed retort extension.

These furnaces are indirect fired and equipped with multi-zone controlled combustion systems which permit operating at temperatures from 600°F to 1850°F. Each control section can be set to provide the desired temperature gradation.

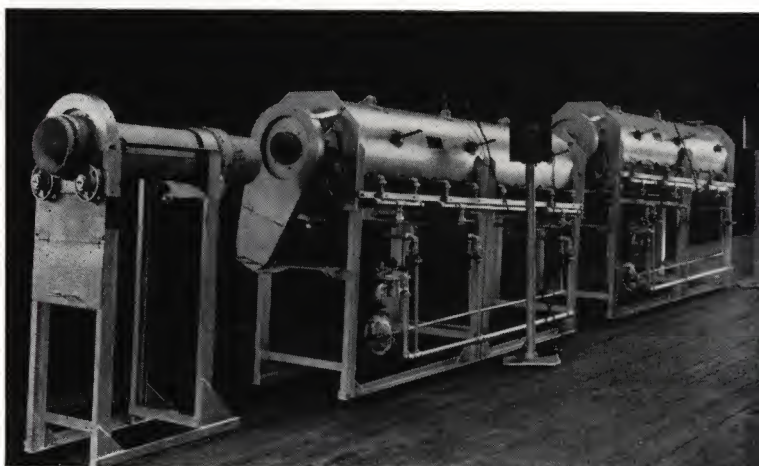




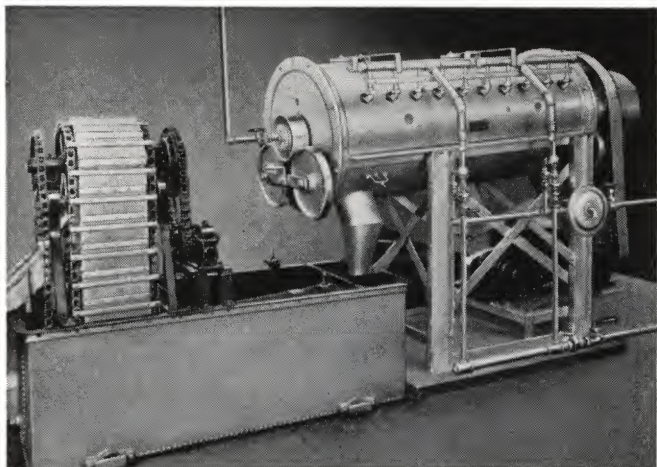
No. 65-D Rotary Retort Continuous Heating Furnace for calcining oxides, carbonates, etc., for the annealing of brass between drawing operations, etc. This furnace has a tilting mechanism, automatic feeding hopper and also an adjustable feed to regulate heating time.

Furnace No.	Capacity lbs. of steel heated to 1500°F.	Inside Diameter of Retort	Available Length in Retort	Spiral		Max. Gas. Cons. (1050 B.T.U.) (cu. ft./hr.)	Gas required for holding 1550°F. (cu. ft./hr.)	Max. Air Required cu. ft./min. at 16 oz.
				Width	Height			
*65D	300 to 500	14 3/4"	4'-2"	6"	1"	375	87	67

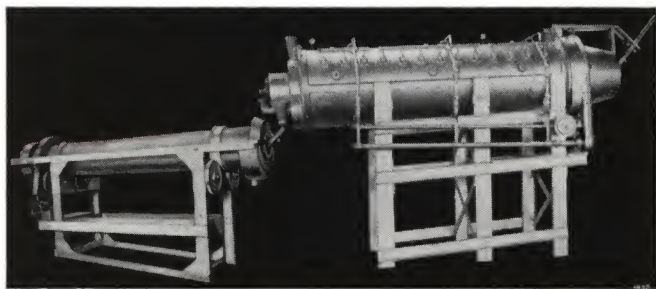
\*External discharge. May also be supplied without spiral.



Three rotary machines with silica retorts to operate in series for special chemical requirement. The two Heating Furnaces at the right have heating chambers 7'-10" long to take a silica tube 6" I.D. x 10'-0" long. They are designed for temperatures to 1400°F.



Rotary Retort Continuous Heating Furnace No. 136-MC with Automatic Quenching Tank.



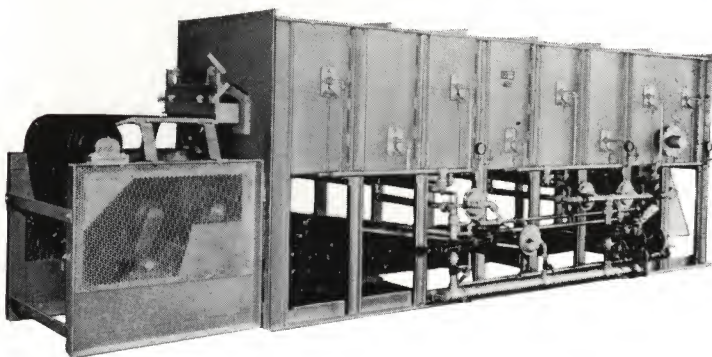
Rotary Retort Continuous Heating Furnace No. 139K and Rotary Retort Continuous Cooling Machine No. 164 designed and supplied especially for burning garnet grain prior to its application to garnet paper. The Heating Furnace is a modification of the No. 139-MD as per pages 11-18.





## **Controlled Atmosphere Mesh Belt Conveyor Furnaces, Series 300**

**with Full Seal Work Discharge Chute  
for Hardening or Tempering**



A.G.F. Series 300 Conveyor Furnaces have a full muffle extending through the heating chamber and sealing into the quench. Work is carried through the muffle on a mesh belt conveyor and dropped into the quench through a fully sealed chute. Work remains under atmosphere protection until it is quenched.

Series 300 Conveyor Furnaces can be operated at temperatures up to 1750°F. Any desired atmosphere and cycle time can be maintained and the lightest and most delicate work can be handled without distortion.

Latest engineering features and refinements provide many operating advantages such as:

- Full seal muffle assures positive control of atmosphere.
- Processing cycle time can be closely regulated and duplicated with the improved conveyor drive mechanism.
- Short processing cycles can be more easily maintained.
- Automatic feeding equipment can be utilized.
- Quieter operation is achieved resulting in better working conditions.





## OPERATIONAL ADVANTAGES

### Uniform and Individualized Treatment.

Each work piece is uniformly heated in a controlled atmosphere.  
Each piece receives its own individualized quench.

### Versatility.

A.G.F. Controlled Atmosphere Conveyor Furnaces can be used without any modification whatsoever for various types of general and atmosphere work such as carburizing, case hardening bright hardening, etc. These furnaces with a modified combustion system and suitable alloy muffle are supplied for atmosphere tempering, either bright or controlled color. The processing time cycle is completely adjustable.

### Positive Atmosphere Control.

Construction enables positive atmosphere control of the desired atmosphere within the muffle.

### Reduced Handling Costs.

Conveyorized feeding mechanisms can be supplied to eliminate costly work handling in charging the furnace.

## CAPACITIES

A.G.F. Series 300 Controlled Atmosphere Conveyor Furnaces are available in various sizes. The actual production rate depends on the weight of the parts relative to their bulk, the cross section of the parts and the desired processing time cycle.

## CONSTRUCTION FEATURES:

### Stationary Alloy Muffle.

The stationary alloy muffle completely encloses the heated portion of the conveyor belt. The discharge throat of the muffle is equipped with a discharge chute that extends into and well below the surface of the quenching medium, thus providing a 100% atmosphere seal at the discharge end.

A piloted type fume eductor is provided for the discharge throat of the muffle to exhaust any contaminating quenching medium vapors and to ignite them if they are flammable.



The muffle is of the best available heat-resisting alloy, composition 60% nickel, 12% chromium, to withstand operation at temperatures of 1750°F. Numerous heat-resisting alloy supports are employed to uniformly support the muffle on the refractory piers located in the furnace heating chamber.

### Alloy Mesh Wire Conveyor Belt.

The work conveying mesh wire belt is supplied of high grade heat resisting alloy material, exact specifications of construction to depend upon the work to be handled.

### Simple, Trouble-Free Drive.

A friction drive arrangement is employed at the charging end of the furnace. The conveyor belt drive pulley is driven by a variable speed motor drive. A pressure roll arrangement is utilized to insure maximum surface contact and traction, thus reducing belt strain.

### High Quality, High Efficiency Lining.

The lining comprises 4½" of high grade insulating refractory backed up with a suitable thickness of block insulation. This type of construction has low heat storage and low heat loss factors and is employed to achieve faster heating-up and more economical operation.

## SERIES 300 CONTROLLED ATMOSPHERE MESH BELT CONVEYOR FURNACES

Conveyor Furnace Model No.	Muffle		Conveyor Belt		Operating Data			
	Available Height	Approx. Heated Length	Width	Heated Length	Max. Air Req. Cu. Ft./Min. at 1½ lbs. sq./in.	Gas Consumption		Muffle Atmosphere Gas Required Cu. Ft./Hr.
						1050 B.T.U. Natural Gas Cu. Ft./Hr.	B.T.U./Hr.	
315	5½"	120"	18"	110"	135	725	761,250	525
320	2½"	204"	24"	186"	188	1,090	1,141,350	425



## Combustion System.

The new Series 300 Controlled Atmosphere Conveyor Furnaces are equipped with multi-zone combustion systems which are designed to achieve extremely uniform and rapid heating of the muffle. Maximum temperature uniformity is assured by the use of many burners firing into both sides of the amply sized combustion chamber, both above and below the muffle.

Each burner has a relatively small heat input and is sized according to its location on the furnace to obtain uniform heat distribution and temperature. Manifolding of the burners is arranged to permit the heat input of various burner sections to be adjusted for balancing out.

## Casing.

The furnace casing is constructed of welded steel plate suitably reinforced with structural members welded and bolted together. The belt drive arrangement is mounted on a suitable structural steel framework integral with the furnace casing.

## Processing Time Cycle Regulations.

The control of the processing time cycle is completely flexible and can be accurately controlled by regulation of the variable speed motor drive.

## ATMOSPHERE GAS CONTROL

A.G.F. Atmosphere Gas Mixing Cabinets as illustrated on page 167 are supplied to enable the measurement and control of the flow of the atmosphere gases that are to be introduced into the muffle of the furnace.

## AUTOMATIC QUENCHING TANKS

Completely automatic Quenching Tanks as described on pages 35-40 are supplied for use with Series 300 Conveyor Furnaces. A.G.F. Quenching Tanks can be supplied for oil, water or brine quenching.

## AUTOMATIC WASHING AND TEMPERING EQUIPMENT

Automatic washing and tempering equipment can be supplied for use in conjunction with A.G.F. Series 300 Conveyor Furnaces and Automatic Quenching Tanks.



## Controlled Atmosphere Mesh Belt Conveyor Furnaces with Water Jacketed Cooling Extension

A.G.F. Mesh Belt Conveyor Furnaces have either an "A" shaped full muffle or horizontal muffle extending through the heating and cooling zones which provides positive atmosphere control. Horizontal muffles are employed for longer work pieces which cannot be handled in an "A" shaped muffle. Work can be heated for annealing, silver soldering or the slow cool Ni-Carb process of ammonia-gas case hardening. The work is cooled while it remains in the protective atmosphere.

### Capacity.

The actual production rate depends upon the weight of the parts relative to their bulk, the treatment or process being used and the time cycle.

### Lining.

The furnace lining comprises 4½" of high grade insulating refractory backed up with block insulation to insure fast and efficient heating.

### Alloy Muffle.

The alloy muffle in the heating chamber is supported on heat resisting alloy bars resting on refractory piers. Uniform heating is achieved by numerous burners firing above and beneath the muffle from both sides of the furnace.

The muffle in the heating chamber is manufactured of heat resisting alloy, composition 60% nickel, 12% chromium.

The work entering end and the discharge end sections of the muffle are equipped with sliding doors to close down entrance openings to a proper height required to conserve the use of atmosphere gas.

### Conveyor Drive.

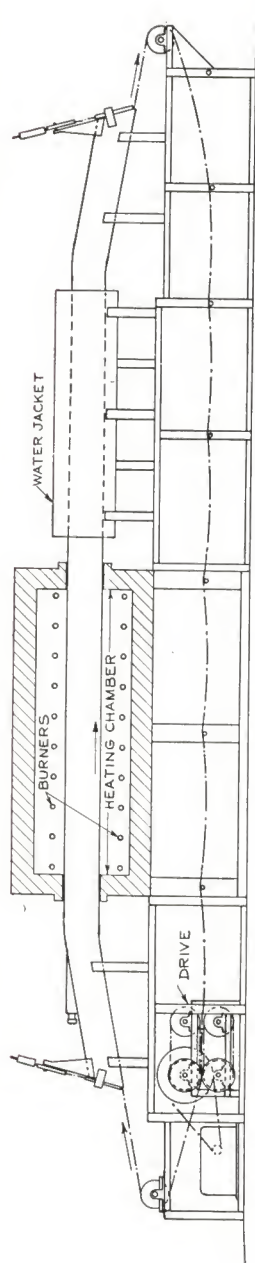
The alloy mesh wire conveyor belt is driven at the work entering end by means of a rubber covered driven pulley and pinch roll. The coldest portion of the belt pulls the greatest proportion of weight which comprises the cold return loop of the conveyor as well as the work load in the cooling chamber. Suitable take-ups are provided and the drive mechanism is equipped with a variable speed drive.

### Combustion System.

The furnace chamber is heated by means of numerous alloy burners firing through super refractory burner tunnels. Each of the burners has an individual pilot burner for ease in lighting. Complete on-off burner operation provides unlimited turn-down, permitting holding any desired temperature without sacrificing maximum production capacity.

The furnace burners are arranged in multiple control zones to suit the application.





## Controlled Atmosphere Mesh Belt Conveyor Heating Furnaces With Water Jacketed Cooling Extension

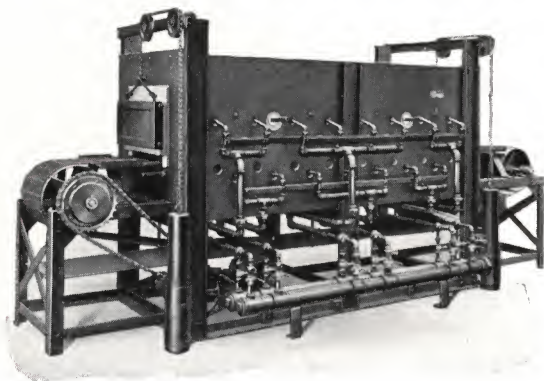
Heating Furnace No.	Conveyor Width	Available Height	Heating Chamber Length	Water Jacket Length	Max. Cons. 1050 B.T.U. Gas C.F.H.	Max. Air C.F.M. at 16 oz.	Floor Space
193*	12"	2"	144"	216"†	475	64	49' lg. x 4'9" w.
206	18"	9"	96"	166"	450	60	40'6" lg. x 6' w.
207	12"	9"	72"	118"	285	39	33'6" lg. x 5'6" w.

\*Flat Muffle, not A-shaped.

†Cooling extension consists of 6-ft. insulated extension, 6-ft. uninsulated, and 6-ft. water jacketed.



## Mesh Belt Conveyor Heating Furnaces



No. 162 Heating Furnace

THESE mesh belt conveyor furnaces are supplied either with or without a muffle and with internal or external discharge of the work for hardening, annealing, normalizing, etc., of work which cannot conveniently be conveyed through the heat by other means.

These furnaces may be supplied for temperatures up to 1900°F. with full muffle, or up to 2100°F. without muffle.

Heating Furnace No.	Capacity in Lbs. Per Hour	Belt Width		Entrance Size				Length Heating Chamber	Max. Gas Cu. Ft./Hr. (1050 B.T.U.)	Max. Air*Cu. Ft./Min. At 16 Oz. Pressure
				Without Muffle		With Muffle				
		Without Muffle	With Muffle	Width	Height	Width	Height			
162	250 to 400	18"	15"	20"	8"	17"	8"	96"	390	55
208	150 to 175	12"	10"	14"	7"	12"	6"	50"	275	40

Floor Space: No. 162 - 15' x 5'2"  
No. 208 - 10'6" x 4'9".



## Chain Belt Conveyor Heat Treating Furnace

THE No. 192 Conveyor Heating Furnace illustrated on following page has a heavy cast heat-resisting alloy solid link belt conveyor 3' wide, inside length of heating chamber 14'.

It is intended especially for the hardening of a wide variety of forgings, including rifle and revolver parts.

Work is discharged at temperature from the point where the belt turns over its pulley through a chute in the bottom of the furnace.

By draining the quenching tank, it is also used for the normalizing of forgings in which case the work is uniformly distributed on the quench tank conveyor for uniform cooling.

Over and under firing from both sides insure uniform heating.

The belt remains within the furnace at all times, being exposed only at the point where work is loaded onto it.

A dead-weight take-up is provided at the charging end.

The door at the charging end is adjustable. A large door at the discharge is convenient for observation of the work and its removal by hand if desired.

### Specifications on No. 192 Conveyor Heating Furnace:

Available width—3'-0".

Available length—14'-0".

Entrance height—4".

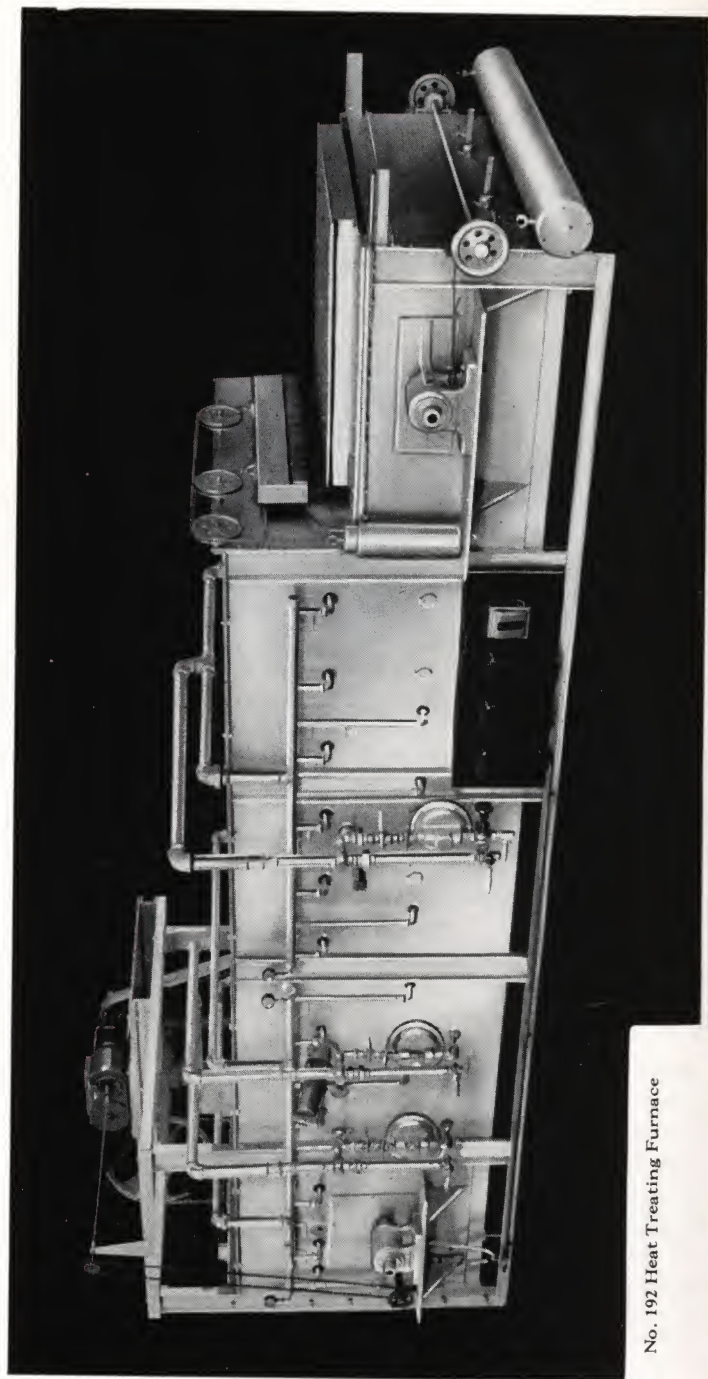
Capacity—1000 to 1500 lbs. per hr.

Maximum gas consumption—1250 cubic feet of 1050 B.T.U. natural gas per hour.

Gas consumption for maintaining at 1500°F.—400 cu. ft. per hr. of 1050 B.T.U. gas.

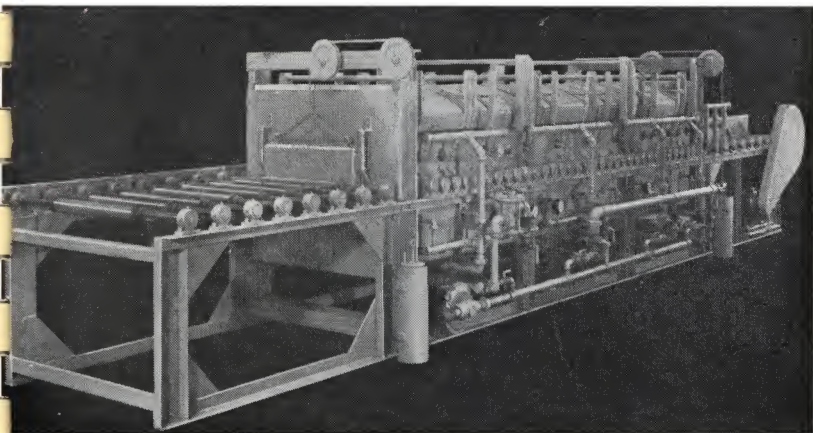
Maximum air—200 C.F.M. at 16 oz.

Floor space required—23'-0" x 9'-0".

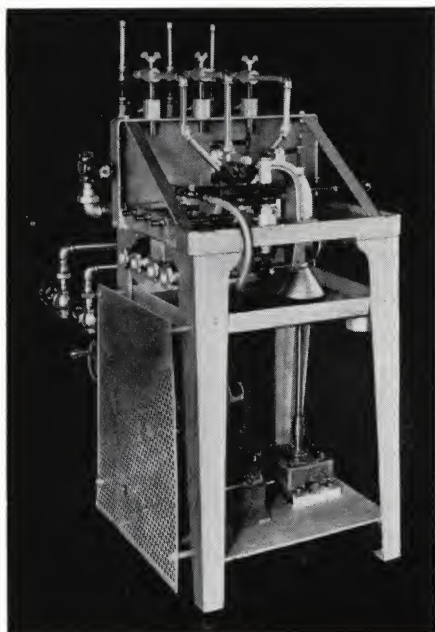


No. 192 Heat Treating Furnace





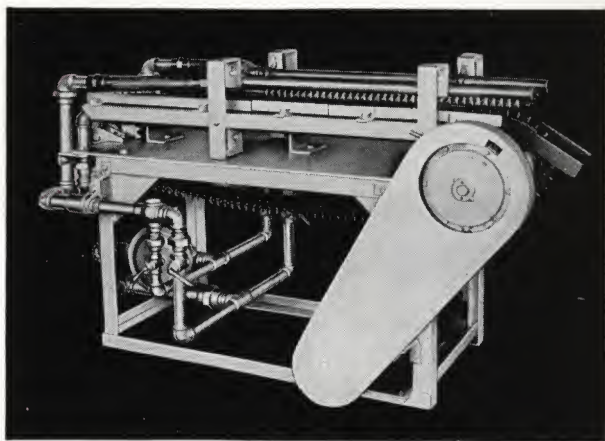
No. 148-A Roller Hearth Heating Furnace, with available heating space 24" wide, 156" long, and 3" high. The alloy rollers are 2½" in diameter on 4½" centers and are all driven from a common drive, consequently comparatively small work can be handled advantageously.



No. 181 Heating Machine for the continuous hardening of the teeth only of band saws. This machine is fully adjustable for various thicknesses and widths of saws. Somewhat similar machines are also supplied for hardening the teeth of hack saws.



## Continuous Flame Hardening and Heating Machines



No. 190 Heating Machine

**T**HIS class of machine is ready for operation immediately upon lighting up. There is no chamber, retort or conveyor to be heated. They usually have a very high capacity because of the rapid heating obtained with them which is ordinarily gauged by the speed at which the operator can feed work onto the conveyor.

Numerous applications, such as annealing the ends of brass tubes, annealing the threads on hardened screws, hardening the heads of screws, annealing the tangs of knife blades, drawing the temper of chisels, punches, etc., are found for these machines.

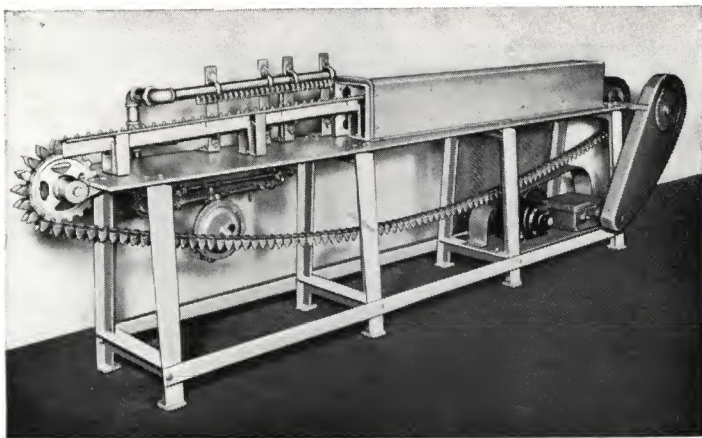
### Specifications of No. 190 Heating Machine:

Length of burner flame to strike work from above and below on both ends—36".

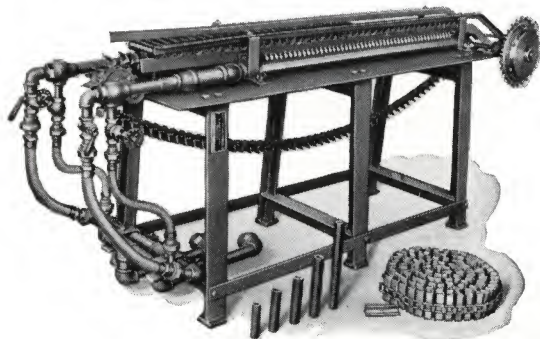
Length of charging extension—30".

Conveyor speeds— $4\frac{3}{4}$ " to 24" per minute.

Maximum gas consumption—360 cubic feet per hour of 1050 B.T.U. Gas.



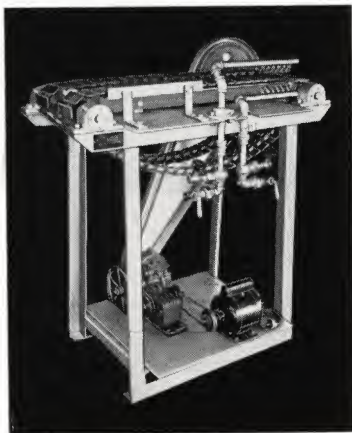
No. 204 Heating Machine for annealing the mouths of steel cartridge cases. Fingers on the conveyor roll the cases past the open flame burners and into an insulated cooling chamber. Variable speed drive is provided.



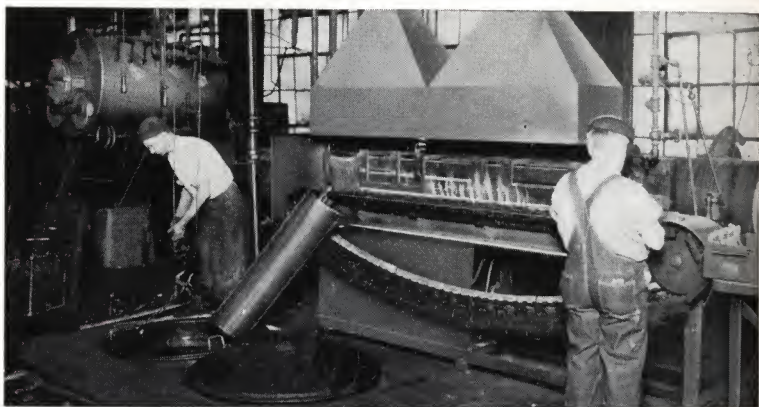
No. 154 Heating Machine for annealing the ends of brass flashlight tubes, plumber's fittings, etc.

With these automatic flame heating machines production begins the moment burners are lighted. Bolt heads, screwdriver ends, portions of shafts, tangs of knife blades, threads of hardened screws, etc., are rapidly, efficiently and uniformly hardened or annealed, as required.

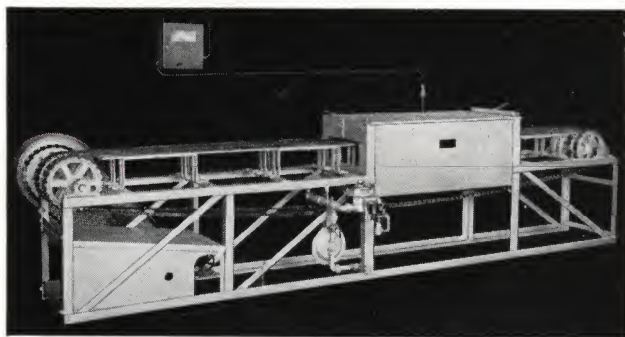
No. 194 Heating Machine. This was originally made to anneal the ends of long springs, however, it may be used for a wide variety of similar purposes.







No. 100-B Heating Machine for hardening the ends of pliers, cold chisels, punches, etc., on a production basis. This machine has a heating chamber 6'-4" long and a 2' charging extension. The available heating width is approximately 3½". The conveyor plates tilt and discharge the work from temperature. A variable speed drive is provided.

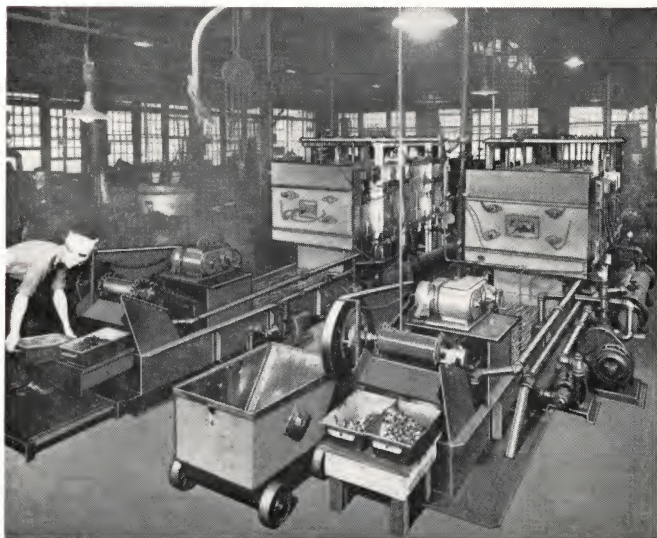


No. 184 Heating Machine for heating pocketbook frames which are soldered by simply touching the fluxed solder wire to the frame at the proper point as the work comes out of the heat. This machine eliminates six operators by having four (4) conveyor chains passing through a heating chamber 48" long. The outer two are on 10⅜" center distance and the inner two on 4⅞". The available height is approximately 1", width 13".





## Mesh Belt Conveyor Quench Tanks



Two Quenching Tanks used in conjunction with Shaker Hearth Furnaces in the heat treatment of bolts, screws, nuts, pins etc.

CYLINDRICAL  
FURNACES

OVEN  
FURNACES

AUTOMATIC  
QUENCH TANKS

FURNACES

BATCH TYPE  
RETORT

FURNACES

MUFFLE  
FURNACES

FURNACES

TUBE

FURNACES

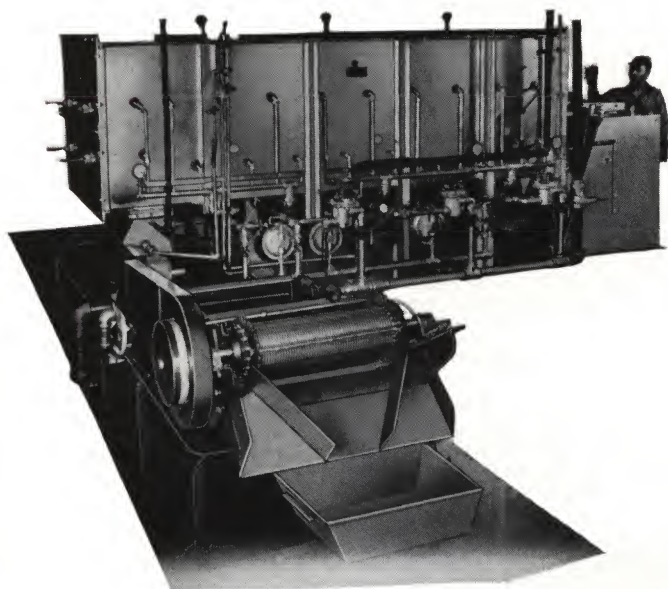
BELL RETORT  
FURNACES

AMMONIA  
DISSOCIATORS





## Automatic Quenching Tanks



A.G.F. Automatic Quenching Tanks are designed especially for use with A.G.F. Continuous Reciprocating Furnaces and Rotary Retort Furnaces. The quenching of heat treated parts is equally as important as the processing in the furnace. Automatic Quenching Tanks used in conjunction with continuous production furnaces assure consistently uniform quality results. The automatic conveyor in the Quenching Tank moves the parts away as they fall on to it, thus insuring that hot parts being discharged from the furnace are not deposited on parts that have already been cooled.

To further insure proper quenching, the conveyor in A.G.F. Automatic Quenching Tanks travels horizontally for a distance along the bottom of the tank before it starts its upward travel to the discharge chute.

The independent recirculating system which is built into A.G.F. Automatic Quenching Tanks employs nozzles mounted into a manifold to agitate and circulate the oil near the discharge chute of the heat treating furnace. The oil in the tank is passed rapidly around the hot work parts as they fall through the oil on to the conveyor.



The use of an Automatic Quenching Tank reduces work handling labor. The continuous heat treating furnace discharges its work into the Quench Tank from where it discharges into suitable containers or into other subsequent processing devices such as automatic washing and tempering equipment. A typical installation of an Automatic Quenching Tank with automatic washing and tempering equipment, is shown on page 7 and index preceding page 1.

## OIL QUENCH

A.G.F. Automatic Quenching Tanks are regularly supplied for oil quenching. A centrifugal pump is provided for recirculating the oil within the tank.

## WATER QUENCH

A.G.F. Automatic Quenching tanks can be equipped with a stainless steel mesh wire conveyor belt, corrosion resistant drive parts, water recirculating pump, etc. for water or brine quenching.

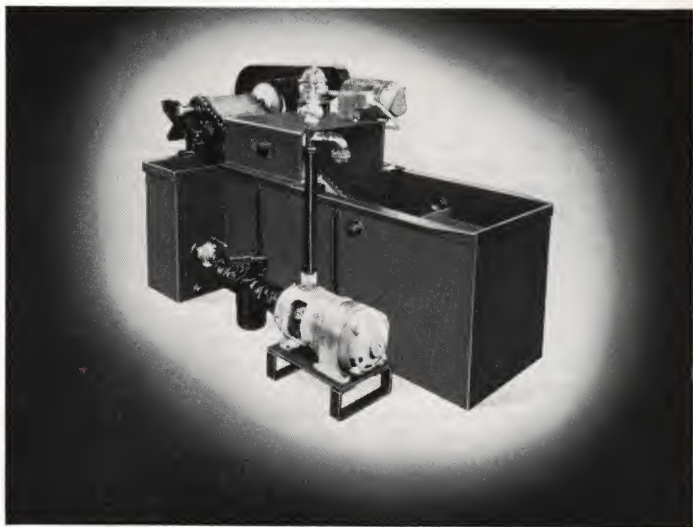
## INSTALLATION

A.G.F. Automatic Quenching Tanks can be installed either "in line" or at "right angle" to the continuous furnace as shown in the illustration on page 7.

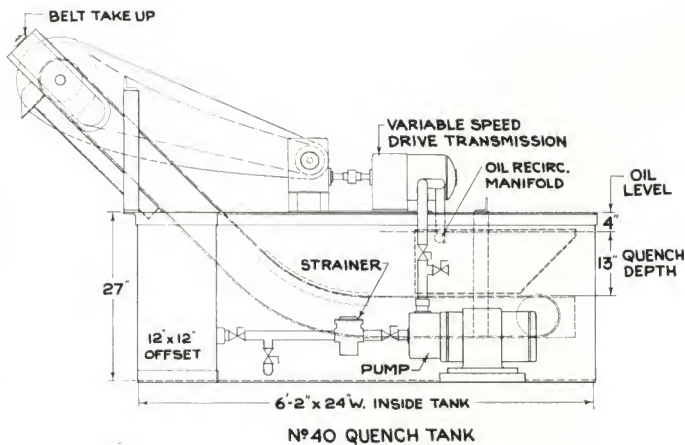
## GENERAL CONSTRUCTION

### Tank

The Tank shell is fabricated of heavy sheet steel, suitably reinforced with structural steel members welded and bolted together. An inner chute extending below the top retaining edges of the belt is provided within the tank to insure that work







**Nº40 QUENCH TANK**

Model 40 Quenching Tank shown above has a 13" quenching depth which is suitable for handling relatively light parts. See specifications on page 39. This size does not require a pit type installation. The line drawing above shows the location of the strainer, recirculating pump and path of travel of the conveyor.

pieces fall on to the belt. All inside and outside surfaces of the tank are heavily coated with special paint suited for oil, water or brine service.

## Conveyor

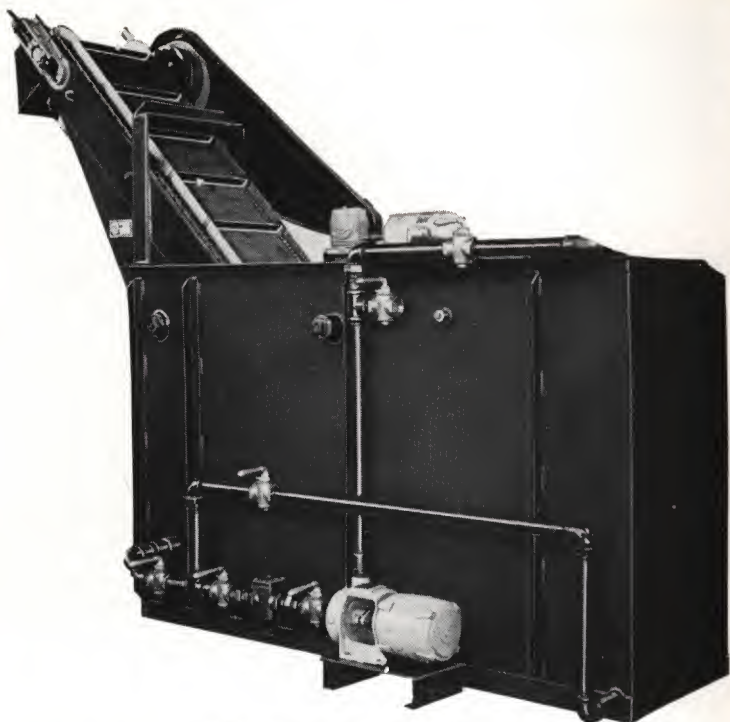
A.G.F. Automatic Quenching Tanks are regularly equipped with steel cord weave mesh wire belts, wire diameter .041", .054" or .080", having from 6 to 11 cross wires per inch. For heavy work pieces, a flexible plate type conveyor can be supplied. The size, shape and weight of work pieces to be handled in any particular tank determine the type of belt that is supplied.

The mesh wire belts in A.G.F. Automatic Quenching Tanks are equipped with flex-plate retaining edges and with suitable steel cross flights. For special applications, the cross flights can be covered with the mesh wire fabric material at a slight additional charge. Cross supporting bars spaced at regular intervals are provided on the belt fabric. Hardened roller chain with suitable attachments is affixed to the cross supporting bars, thus insuring positive support and driving of the belt, without the possibility of damaging it. The chain used is of the extended pitch type having rollers larger in diameter than the chain side pieces, thus permitting the conveyor to roll along the supporting framework.

The discharge end of the conveyor extends well out of the tank permitting convenient placement of containers to receive the work. Where the work pieces are to be discharged into automatic washing and tempering equipment, the conveyor can be specially constructed to discharge at any desired height.

## Conveyor Drive

The conveyors of the various Automatic Quenching Tanks as listed on page 39 are normally driven by either a  $\frac{1}{2}$ ,  $\frac{3}{4}$ , or 1 h.p. variable speed transmission having a speed variation of 4 to 1. A clutch mechanism is provided on the belt drive to prevent



Model 49 Automatic Quenching Tank

tearing or damaging the belt in the event of accidental jamming of the conveyor.

Suitable safety guards are provided on all moving conveyor drive parts.

### Clean-Out Provisions

Clean-out holes are optional and can be supplied if they are desired. In most cases the conveyor frame with its attachments including the conveyor belt is integral and may be removed with a minimum of disassembling to gain access to the interior of the tank.

### Recirculating Pump

An amply sized centrifugal type pump with strainer is supplied with the Automatic Quenching Tank. The pump is located below the oil level so that priming is not required. The Quenching Tank is piped up so as to circulate the oil from the discharge end of the tank to the circulating manifold which is located near the work discharge chute of the heat treating furnace.

The hot work pieces come into contact with continuously circulating and agitated oil for the most efficient quenching. Oil fumes are reduced to minimum or are entirely eliminated.

### OIL COOLING

In addition to circulation, cooling of the oil is necessary. If provisions for cooling of the oil are not available, a completely self-contained and automatic cooler can be supplied.

# QUENCHING TANK SPECIFICATIONS

Tank No.	Type Conveyor	Conveyor Width	Quench Depth	Discharge Height	Inclination of Conveyor	Length of Horiz. Run of Conveyor	Cross Flights		Conveyor Drive		Recirculating Pump			Tank Body				Approx. Floor Space	Approx. Overall Height	Approximate Shipping Weight
							Height	Center to Center Distance	H.P.	Transmission Ratio	Type	H.P.	Capacity Gals./Min	Length	Width	Depth	Capacity Gals.			
43	Mesh Belt	13"	14"	36"	30°	12"	1"	12"	1/2	4-1	Centri-Fugal	1 1/2	100	6'-2"	2'	2'-3 1/2"	175	4'x8'	4'-6"	1,500
40	Mesh Belt	13"	13"	43"	45°	30"	1"	12"	1/2	4-1	"	"	"	6'-2"	2'	2'-3"	175	4'x8'-6"	5'	1,550
40A	Mesh Belt	13"	13"	60"	45°	30"	1"	12"	1/2	4-1	"	"	"	6'-2"	2'	2'-3"	175	4'x9'-6"	6'-6"	1,650
49	Mesh Belt	13"	16"	27"	30°	15"	1"	12"	1/2	4-1	"	"	"	6'-2"	2'	2'-3 1/2"	175	4'x8'	3'-7"	1,465
50	Mesh Belt	13"	16"	42"	30°	15"	1"	12"	3/4	4-1	"	"	"	6'-2"	2'	2'-3 1/2"	175	4'x9'-6"	5'	1,700
45	Mesh Belt	13"	24"	77"	45°	30"	1 1/2"	9"	1/2	4-1	"	"	"	8'	2'	3'-8"	450	4'x11'-6"	8'	2,950
35A	Mesh Belt	13"	36"	76"	45°	18"	1 1/2"	9"	1/2	4-1	"	"	"	8'	2'	4'-10"	540	4'x10'-6"	8'-3"	3,350
35B	Mesh Belt	13"	36"	107"	45°	18"	1 1/2"	9"	1/2	4-1	"	"	"	8'	2'	4'-10"	540	4'x13'	10'-9"	3,550
10FC	Plate	16"	32"	60"	28°	30"	1"	12"	3/4	4-1	"	"	"	12'	2'-2"	4'-10"	840	4'x13'-6"	7'-6"	4,100
222B	Plate	18"	20"	48"	28°	48"	1"	12"	3/4	4-1	"	"	"	12'	3'-6"	3'-3"	940	5'x14'-6"	5'-8"	4,500
37	Mesh Belt	18"	28"	52"	30°	24"	1"	12"	3/4	4-1	"	"	"	12'	2'-4"	4'-1"	855	4'x13'-3"	7'	3,560
51	Mesh Belt	18"	36"	90"	45°	18"	1 1/2"	12"	1	4-1	Immer-sion	1 1/2	100	8'	3'-7"	5'	1,050	5'x11'	9'	4,000

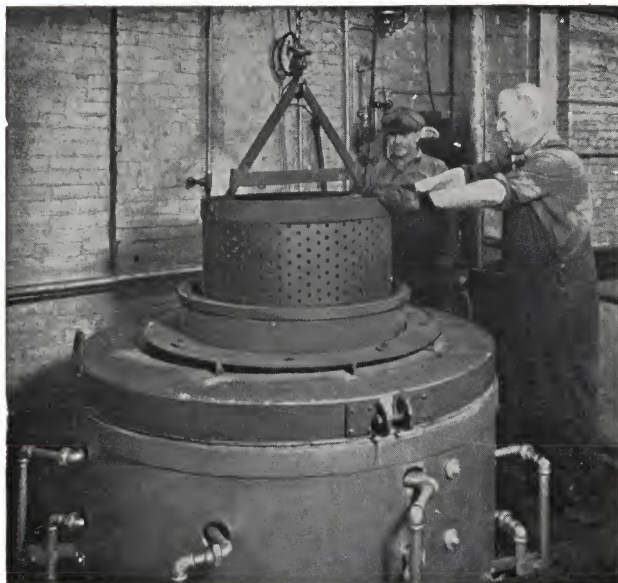
(Tabulation continued on following page)



# QUENCHING TANK SPECIFICATIONS

Tank No.	Type Conveyor	Conveyor Width	Quench Depth	Discharge Height	Inclination of Conveyor	Length of Horiz. Run of Conveyor	Cross Flights		Conveyor Drive		Recirculating Pump			Tank Body			Approx. Floor Space	Approx. Overall Height	Approximate Shipping Weight	
							Height	Center to Center Distance	H.P.	Transmission Ratio	Type	H.P.	Capacity Gals./Min.	Length	Width	Depth				Capacity Gals.
44	Mesh Belt	18"	36"	90"	45°	12"	1½"	12"	1	4-1	Centri-Fugal	1½	100	8'	2'-6"	5'	750	4'-6"x11'	9'	3,750
31C	Mesh Belt	18"	60"	111"	30°	24"	1½"	12"	1	4-1	"	"	"	16'	2'-6"	7'	1,700	4'x21'	11'	6,350
36	Mesh Belt	24"	20"	70"	45°	30"	1"	12"	¾	4-1	"	"	"	9'	3'	3'-4"	675	5'x12'	7'-6"	3,800
30F	Mesh Belt	24"	32"	63"	30°	24"	1"	12"	¾	4-1	"	"	"	12'	3'	4'-10"	1,200	5'x13'-3"	7'	4,500
30E	Mesh Belt	24"	36"	85"	30°	24"	1"	12"	¾	4-1	"	"	"	12'	3'	5'	1,245	5'x15'-6"	8'-6"	5,200
30G	Mesh Belt	24"	36"	100"	30°	24"	1"	12"	¾	4-1	"	"	"	12'	3'	5'	1,245	5'x18'-9"	10'	5,500
32	Mesh Belt	30"	18"	36"	30°	18"	1"	9"	½	10-1	"	"	"	7'-8"	4'-7"	2'-8"	660	5'x9'	4'-6"	3,500
22C	Plate	30"	32"	60"	28°	24"	1"	12"	¾	4-1	"	"	"	12'	3'-6"	4'-9"	1,400	5'x14'-6"	7'-6"	5,800
47A	Plate	30"	34"	90"	30°	24"	3"	12"	1	4-1	"	5	300	12'	3'-8"	5'	1,650	5'-6'x19'	11'	7,000
41	Mesh Belt	30"	34"	65"	45°	12"	1½"	9"	¾	4-1	"	1½	100	8'	3'-6"	5'	1,575	5'x9'-6"	7'-2"	5,000
42	Mesh Belt	32"	30"	89"	30°	30"	1"	18"	¾	4-1	"	"	"	12'	3'-8"	5'	1,650	5'6'x17'6"	9'-6"	6,000
46	Mesh Belt	32"	36"	89"	30°	24"	2"	12"	¾	4-1	"	"	"	12'	3'-8"	5'	1,650	5'x17'	8'	7,500
48	Mesh Belt	44"	38"	72"	35°	18"	2"	12"	¾	4-1	"	"	"	10'-6"	4'10"	5'	1,875	6'x12'	7'-4"	6,700





Charging a Vertical Carburizer. Automatic Temperature Control is employed with the thermocouple located in the combustion chamber. Some installations are now using the thermocouple inside the retort.

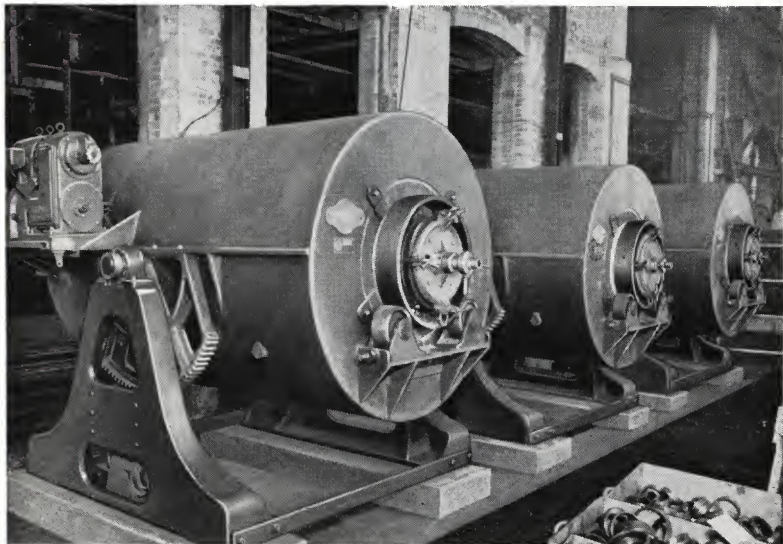
**Rotary Retort Furnaces**  
**Vertical Retort Furnaces**  
  
**for Carburizing and**  
**Other Processes**

CYLINDRICAL  
FURNACES  
AL  
FLO  
OVEN  
FURNACES  
POT  
FURNACES  
BATCH TYPE  
RETORT  
FURNACES  
MUFFLE  
FURNACES  
TUBE  
FURNACES  
BELL RETORT  
FURNACES  
AMMONIA  
DISSOCIATORS



# Rotary Retort Furnaces Batch Type

for Carburizing, Hardening,  
Annealing or High Temperature Calcining  
and Roasting



Battery of No. 4 Rotary Retort Furnaces

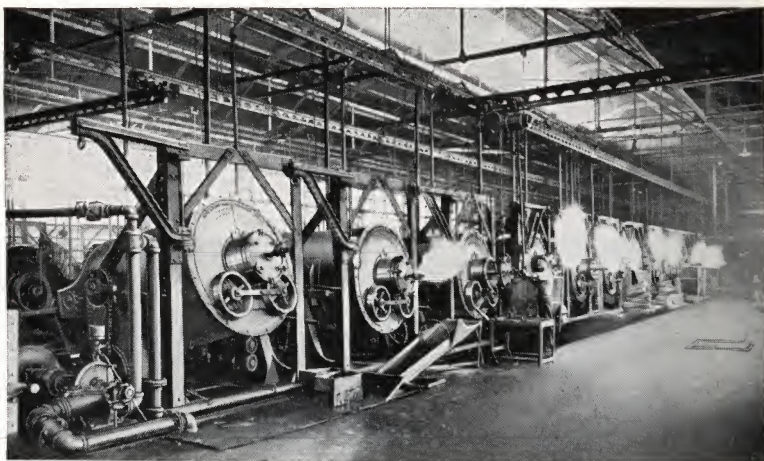
A.G.F. Batch Type Rotary Retort Furnaces (also known as Rotary Carburizers) are extensively used for carburizing with either gas or compound. These furnaces are also excellently adapted for ammonia-gas case hardening, annealing or normalizing under a controlled atmosphere. The furnace is so constructed that any desired atmosphere can be introduced into the sealed retort.

A.G.F. Batch Type Rotary Retort Furnaces are also extensively used in the chemical industry for roasting, calcining, etc.

## Advantages

1. **Uniformity.** Gentle mixing from retort rotation assures uniformity of temperature, allowing rapid heat-up without overheating any part of the load.
2. **Versatility.** Construction and combustion system of furnaces permits use for wide variety of work under atmosphere control at temperatures to 1800°F. A wide variety of work can be carburized or heated in the same furnace in independent charges—the time, temperature, etc. being fixed for each load.
3. **Tilting.** Easily operated tilting device minimizes labor of charging and discharging. Work can be quenched directly





Battery of Rotary Carburizing Furnaces.

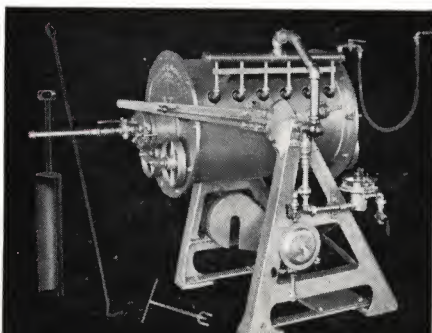
from the furnace without additional handling, or slow cooled as desired.

4. **By using gas** as a carburizing medium, or through the use of loose compound in the retort, the tedious handling and upkeep of boxes, etc. is eliminated.
5. **Low Upkeep.** Heavy walled alloy retort, location of moving parts outside the heat and sturdy construction throughout result in extremely low upkeep.
6. **Low operating cost.** Because the retort remains in the furnace at all times and because the latest types of insulating refractory lining is used, thermal efficiency is high and retort life is long.

Rotary Furnace No.	Capacity 2/3 full cu. in.	Approximate Charge Capacity Lbs. (Steel Parts)	Retort		Operating Data		Carb'g. Gas C.F.H.
			Inside Dia.	Available Length	Max. Air 1 lb./sq. in. C.F.M.	Max. Gas 1050 B.T.U. C.F.H.	
*00	95	8 to 12	4"	12"	8	30	30
0	275	25 to 35	5 3/4"	16"	11	45	50
1F	900	60 to 90	7 1/2"	30"	20	125	60
2G	6,000	400 to 500	14 1/2"	45"	52	375	100
2H	6,000	400 to 500	**14 3/4"	48"	52	375	100
4	18,500	1200 to 1500	**24 1/2"	75"	110	660	275

\*This size has short legs for mounting on low table.

\*\*Barrel shaped, 12-sided retort, measured across flats.



No. 1F Rotary Retort Furnace





## Carburizing with Gas

The use of carburizing compound with dust and dirt and additional labor is eliminated by using gas as the carburizing medium. As the carburizing medium, some city gases, natural gas or propane may be employed. Natural gas is generally used as it comes from the supply line. Propane is customarily premixed in the ratio of one part of propane to two parts of air.

## Construction

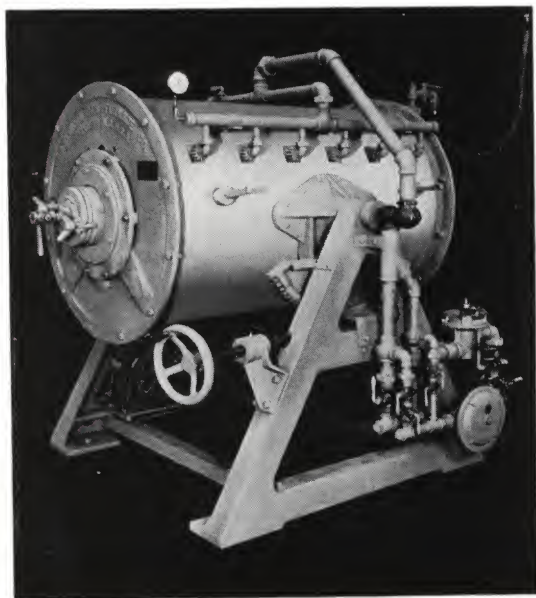
The construction of these furnaces is modern throughout, including lining of insulating refractory backed with block insulation, heat-resisting alloy burners, super refractory burner tunnels, single valve ratio set, heat-resisting alloy retort, etc.

## Combustion System

The furnace is uniformly heated by numerous burners firing tangentially into the heating chamber through super refractory burner tunnels. The smaller model furnaces are arranged for one zone control. The larger models can be furnished with multi-zone control.

## Fuel

Furnaces, are regularly supplied to use manufactured gas, natural gas, mixed gas, propane or butane. Model 2-G, Model 2-H and Model 4-B furnaces can be arranged for oil firing.

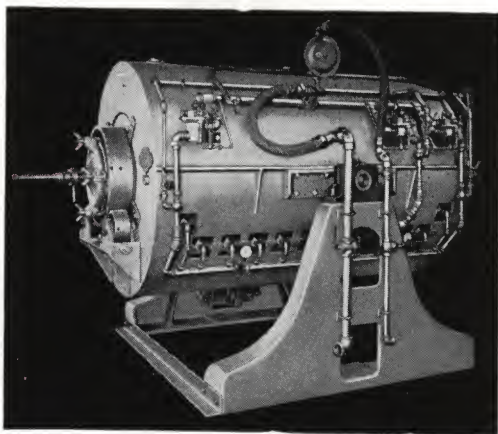


No. 2G  
Rotary  
Furnace

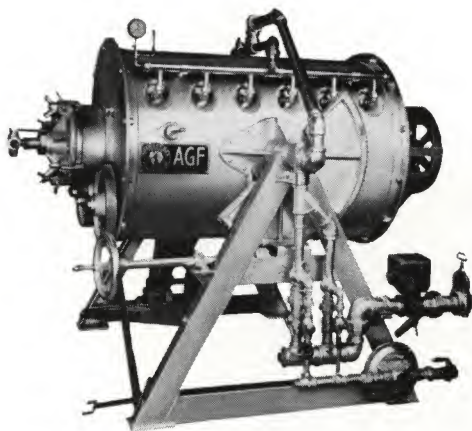


Charging one of a battery of No. 2B Rotary Retort Furnaces

The No. 4 Rotary Retort Carburizers shown on page 41 and below are our latest and largest size furnaces. The retort has 12 sides, 24" across the flats and tapering at the ends to 13½" diameter, inside length being 75", average capacity approximately 1500 pounds of work. It is arranged to use three temperature controls, one at each end and one in the center zone. A wide range of retort speed is provided, plus power tilting.



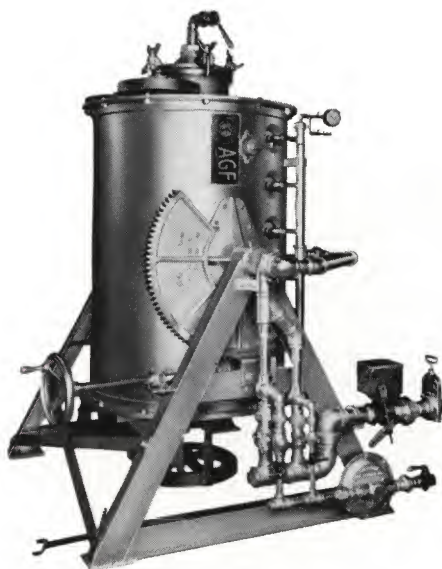
No. 4 Rotary Retort Furnace. Note 3 zone control.



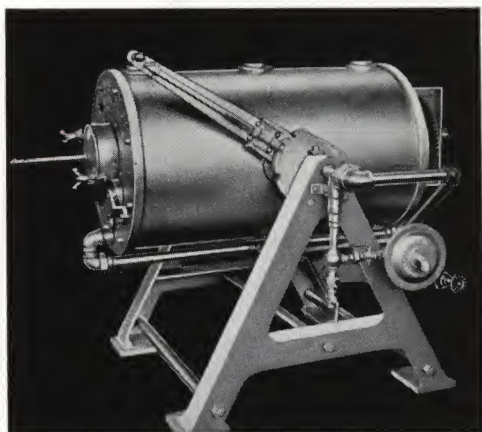
Model 268 Batch Type Rotary Retort Furnace with modified tilting device and drive to permit tilting retort to vertical position, and removal of retort and work from furnace.

General construction, specifications, etc. similar to the Model 2-G Rotary Retort Furnace per page 42. Retort 14½" inside diameter by 45" available heated length.

Illustration above shows furnace in normal horizontal running position. Bottom illustration shows furnace in vertical position for unloading work and/or retort.







## Rotary Retort Furnaces

Batch Type  
for Tempering,  
Coloring or  
Low  
Temperature  
Calcining and  
Roasting

For parts or material which may be gently tumbled, there is no surer way of obtaining uniformity than by the use of A.G.F. Rotary Retort Furnaces.

The slow rotation assures that every portion of the material or work pieces is subjected to the same temperature and atmosphere as every other portion. Heating is exceptionally rapid and far more uniform than can be obtained in a stationary furnace, either with or without convective circulation.

Standard furnaces listed below can be operated at temperatures up to 1000°F.

Ferrous metals may be readily given any specific temper color. Where desired, A.G.F. Rotary Furnaces permit tempering and blackening to be combined into one operation. The resulting black Carbonia Finish\* is rust resistant to a high degree, may be polished, and will not chip, spall or flake off.

\*Carbonia Finish is the original "gun metal finish" introduced by the American Gas Furnace Co., and proven through 50 years successful use.

Furnace No.	Size of Retort In Inches		Size of Entrance or Neck in In. Dia.	CAPACITY				Maximum Gas Consumption 1050 B.T.U. Cu. Ft. Per Hr.
				Half Full		Filled to Entrance Only for Small Work		
	In Cu. Inches	In Lbs.				In Cu. Inches	In Lbs.	
51	15	15¾	6	1,400	60	650	30	60
64	20	30	9	4,700	225	2,150	100	100
64-G	20	32	12	5,050	250	1,425	75	100
64-C	20	32	19½		For	fixture	work	100
71	30	48	18½	18,000	835	4,650	215	313
71-B	28	42	11¼	15,000	645	6,500	280	375

# Vertical Retort Gas Carburizers



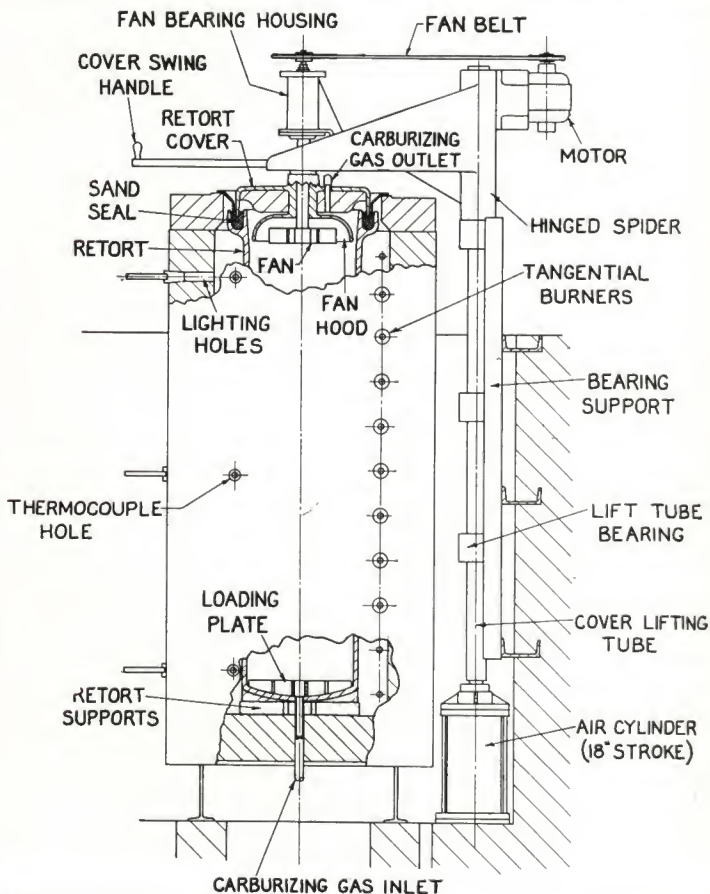
The No. 19-C Vertical Retort Gas Carburizer illustrated above has a retort 30" inside diameter x 45" available depth. This furnace can be equipped with either a top or bottom mounted fan for recirculating the carburizing gas. See tabulation on page 52 for complete specifications.

CYLINDRICAL  
FURNACES  
OVEN  
FURNACES  
POT  
FURNACES  
FORGES  
MUFFLE  
FURNACES  
MELTERS  
TUBE  
FURNACES  
BURNERS  
BELL RETORT  
FURNACES  
AMMONIA  
DISSOCIATORS



## Vertical Retort Gas Carburizers

Vertical Retort Gas Carburizers are suited for work such as bearing races, long shafts, crankshafts, gears and other parts that cannot be handled in Rotary Retort Carburizing Furnaces. Ni-Carbing, clean hardening, clean annealing and other atmosphere work can be performed without modification of the



Nomenclature and cross-sectional diagram of No. 31 Vertical Retort Gas Carburizer with top mounted recirculating fan.

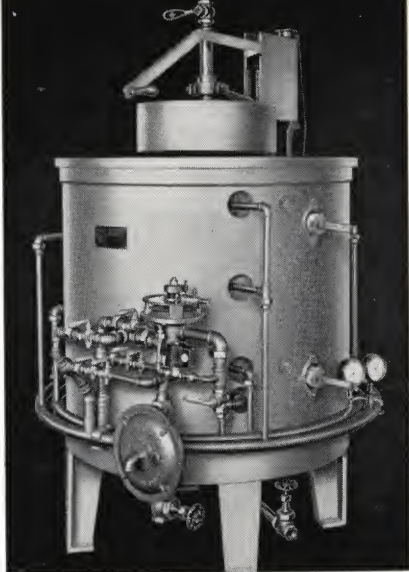


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## Vertical Retort Gas Carburizers

furnace. The atmosphere gas is introduced through a suitable inlet in the bottom of the positively sealed retort, passing through a baffle to insure its uniform circulation around the work. After heat treatment the work can be slow cooled in the furnace, quenched from heat, air cooled or pit cooled.



No. 28 Vertical Gas Carburizer

### Advantages

1. *Uniformity.* The vertical retort is located completely within the furnace chamber. Many small burners fire tangentially into the furnace chamber to eliminate direct flame impingement upon the retort. Heat input is balanced to give uniformity of temperature from top to bottom as well as entirely around the retort, thus insuring uniform carburizing results.

2. *Saving In Labor.* The tedious packing and handling of carburizing boxes is eliminated.

3. *Saving In Time.* Elimination of the use of carburizing compound which acts as an insulator permits the heating cycle to be shortened over old fashioned pack carburizing methods.

4. *Work Handling Facilitated.* Either a heavy bottom plate with eye bolts or baskets can be used for handling the work. Heavy loads are quickly and easily handled with an overhead crane.

5. *Long Alloy Life.* Location of the retort completely within the heat at all times and uniform heating insures long alloy life—normal life expectancy is from 5,000 to 7,500 heat hours service, although some retorts have had a recorded life of up to 30,000 hours.

6. *Furnace and retort cover are quickly and easily operated.* A pneumatic lifting device is employed on the large units and an efficient manually operated mechanism is standard on the smaller models No. 13-H and 28.



## Vertical Retort Gas Carburizers

### General Construction

The furnace casing is fabricated of heavy steel plate and is lined with efficient, high grade insulating refractory backed with block insulation.

### Retort

The heavy walled retort is cast of the best obtainable heat resisting alloy—35% nickel, 15% chromium or 60% nickel, 12% chromium.

### Covers

The inner retort cover which is positioned into a sand seal is of the same alloy as the retort. An outer refractory cover suitably reinforced is employed to close the furnace heating chamber. The complete cover assembly is raised by a pneumatic cylinder on the larger models and by a manual mechanism on the No. 13-H and 28 models.

### Recirculating Fan

The parts of the recirculating fan assembly subject to heat are fabricated of heat resisting alloy. Fan shaft bearings are located away from the heat to reduce maintenance to a minimum.

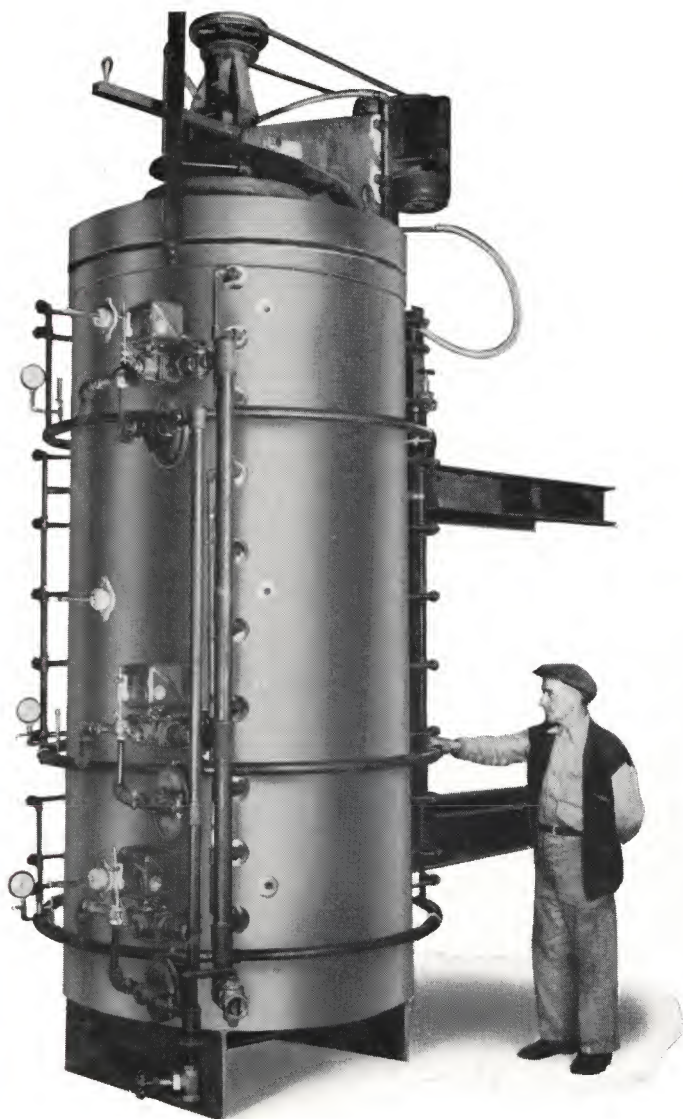
An inner alloy sleeve or work handling baskets with solid walls are employed if the nature of the work requires uni-directional circulation.

### Carburizing Gas

As the carburizing medium, some manufactured gases, natural gas or propane may be employed. Natural gas is generally used simply as it comes from the supply line. Where propane is used, it is customary to premix same in the ratio of one part of propane to two parts of air or to suitably dilute it with prepared atmospheres.

### Location

Vertical Retort Gas Carburizers are normally installed in a concrete lined pit as shown in the illustration on page 48 with the top of the furnace extending up from one to two and a half feet above floor level.



No. 31 Vertical Retort Gas Carburizer, retort 22" inside diameter x 84" available depth, with top mounted fan for recirculation of carburizing gas.

CYLINDRICAL  
FURNACES  
OVEN  
FURNACES  
POT  
FURNACES  
FORGES  
MUFFLE  
FURNACES  
TUBE  
FURNACES  
BELL RETORT  
FURNACES  
AMMONIA  
DISSOCIATORS



# Vertical Retort Gas Carburizers

Vertical Carburizer No.	Retort		Furnace and Retort Cover		Operating Data					Lining		Approximate Pit Dimensions		Net Weight (Approx.) Pounds	Approx. Shipping Weight Pounds
					Inside Dia.	Available Depth	Pneumatically Operated	Manually Operated	Approximate Gas Consumption 1050 B.T.U. Natural Gas Cu. Ft. Per Hr.		Maximum Air Required C.F.M. at 16 oz. Pressure				
	Maximum	Holding at 1700°F.													
28	18"	22"		✓	188 197,000 B.T.U.	45 47,000 B.T.U.	32	50	4½"	2½"	5'-0" x 4'-9"	7'-0" x 7'-0"	3'-0"	3,000	3,400
13-H	15"	32"		✓	230 242,000 B.T.U.	55 58,000 B.T.U.	39	75	4½"	2½"	4'-9" x 4'-6"	7'-8" x 7'-8"	3'-6"	3,500	3,900
§19-C	30"	45"	✓		374 392,000 B.T.U.	100 105,000 B.T.U.	63	100	4½"	4"	6'-9" x 7'-6"	8'-0" x 8'-6"	5'-6"	9,500	10,000
22-C	18"	65"	✓		375 394,000 B.T.U.	100 105,000 B.T.U.	63	110	4½"	4½"	6'-0" x 6'-6"	8'-0" x 8'-6"	8'-0"	10,800	11,500
§23	*48"	56"	✓		475 499,000 B.T.U.	150 158,000 B.T.U.	79	125	9"	4½"	6'-6" x 7'-3"	11'-0" x 12'-0"	8'-3"	25,800	28,000
†31	22"	84"	✓		450 473,000 B.T.U.	150 158,000 B.T.U.	75	100	4½"	4½"	6'-0" x 7'-9"	9'-0" x 9'-6"	9'-0"	22,000	24,000

†Can be furnished with top mounted fan for recirculating carburizing gas.

§Can be furnished with bottom mounted fan for recirculating carburizing gas.

\*Annular shaped retort. Work space dimensions—12¼" inside diameter, 48" outer diameter.



## Muffle and Assay Furnaces

Large Muffle Furnaces  
(Ceramic Muffle)

Muffle Furnaces with Cooling Extension

Controlled Atmosphere Muffle Furnaces

"Bell Oven" Furnaces

Push Through Muffle  
Furnaces

CYLINDRICAL  
FURNACES

OVEN  
FURNACES

POT  
FURNACES

FORGES

MUFFLE  
FURNACES  
MELTERS

TUBE  
FURNACES

BELL RETORT  
FURNACES

AMMONIA  
DISSOCIATORS

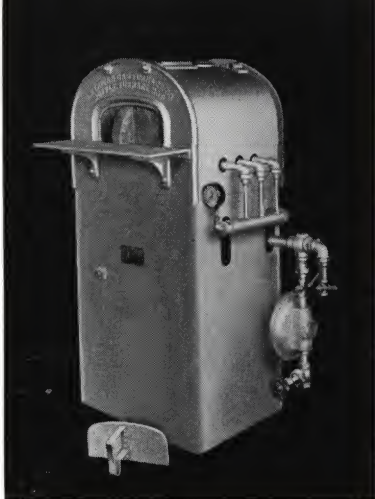




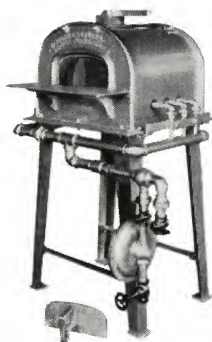


# Muffle and Assay Furnaces

A.G.F. Muffle Furnaces are equipped with full muffles to protect the work from the products of combustion. The lining is of molded hard burned refractory. The furnaces are equipped with alloy burners served by a Single Valve Ratio set mixing system as described on page 158. The furnaces are available with either a streamlined casing as illustrated above or with cast iron legs as shown below. These muffle furnaces are regularly supplied for operation at 2000°F, but special provision can be made to operate at temperatures to 2400°F. Larger sizes are described on page 54.

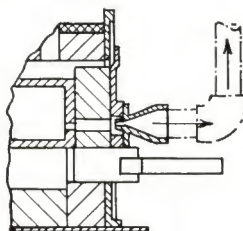


No. 6C Muffle Furnace with streamlined casing.



No. 6 Muffle Furnace with cast iron legs.

Muffle Furnaces equipped with a back draft for circulation of air through muffle are known as Assay Furnaces.

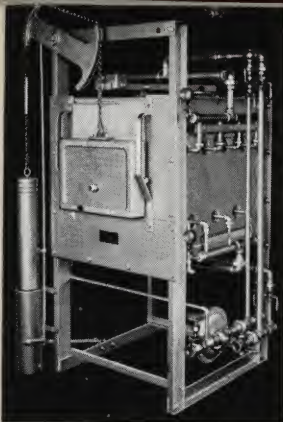


Back Draft For Assaying.

Streamlined Casing		Cast Iron Legs		Inside Dim. of Muffle			Max. Gas Cons. (1050 B.T.U.) cu. ft./hr.	Max. Air Req. at 16 oz. cu. ft./min.
Muffle Furnace No.	Assay Furnace No.	Muffle Furnace No.	Assay Furnace No.	Width	Height	Length		
		*2 1/2 B	*2 1/2 C	4 1/2"	2 3/4"	7 1/2"	40	6
4C	2C	4	2	6 5/8"	3 3/4"	12"	85	12
6C	3C	6	3	12"	5 1/4"	14"	143	19

\*Bench type furnace.

CYLINDRICAL FURNACES  
ALLOY FURNACES  
OVEN FURNACES  
POT FURNACES  
FORGES  
MELTERS  
TUBE FURNACES  
BELL RETORT FURNACES  
AMMONIA DISSOCIATORS



## Large Muffle Furnaces

(Ceramic Muffle)

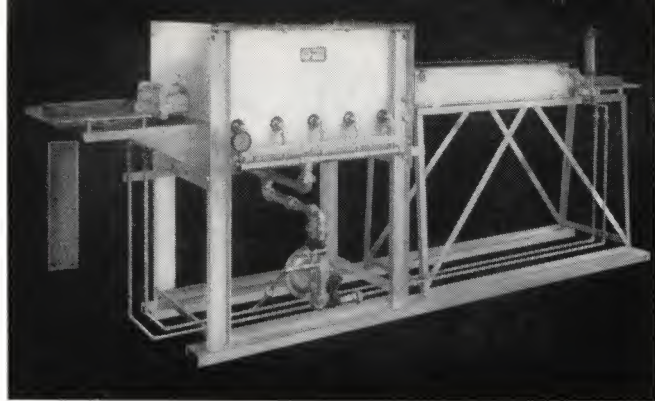
OUR large Muffle Furnaces are similar in construction and outward appearance to the Oven Furnaces shown on pages 91 - 95, but are equipped with high temperature ceramic muffles to protect the work from the products of combustion. Special modifications can be provided, where desired, such as rear venting of the muffle, atmosphere inlet, and door clamping arrangement to seal door tightly against the muffle for containing the atmosphere.

These Muffle Furnaces are usually provided for maximum temperatures ranging from 2000° to 2400°F., as specified when ordering.

Linings are of high temperature insulating refractory backed with block insulation. The burners are served by a Single Valve Ratio Set to give one valve control of gas and air, utilizing gas at line pressure and air at one to two pounds per square inch.

To assure uniformity numerous small burners are employed, the main burners firing above the muffle and just under the arch of the furnace, while supplementary smaller burners fire below the muffle. The products of combustion are forced through vents located beneath the muffle and extending up through the back wall of the furnace.

Furnace No.	Inside Dim. of Muffle				Height from Floor to Entrance	Time to Heat 1500°F.—Hrs.	Standard Max. Temp. Deg. F.	Max. Gas Consumption 1050 B.T.U. C.F.H.	Max. Air Req. C.F.M. at 16 oz. Pressure	No. of Burners		Floor Space
	Width	Side Height	Center Height	Length						Upper	Lower	
27B	9½"	4¼"	4¼"	14"	42"	2	2400	200	30	6	4	53" x 40"
28	13"	4"	6"	17¾"	42"	1	2000	125	17	6	4	40" x 60"
30	14"	4½"	8"	25¼"	43"	1	2000	200	30	8	6	54" x 55"
32	14"	8"	14"	16½"	42"	2	2400	263	35	6	4	56" x 52"
33	14"	7½"	10"	21½"	42"	2	2400	300	40	8	6	48" x 54"
35	8½"	3¾"	5½"	13"	42"	2	2500	300	40	6	4	54" x 46"



## Muffle Furnaces

(Heat Resisting Alloy Muffle with Water Jacketed Cooling Extension)

**T**HIS series of Muffle Furnaces is designed primarily for use in the precious metals and jewelry industries. They are extensively used for the bright annealing of silver and gold, silver soldering, etc.

The furnace heating chamber is lined with efficient high grade insulating refractory and is uniformly heated by numerous alloy burners. The heat resisting alloy muffle has a water jacketed cooling extension. Certain models can be equipped with a bottom door in the cooling extension to permit quenching of gold to achieve the desired physical characteristics. In some cases a water spray quench is used beyond the water-jacketed cooling extension to speed up the cooling operation, thus increasing production.

To provide atmosphere gas, an Ammonia Dissociator, as shown on pages 75-78 can be used, or if preferred bottled atmosphere gas can be used.

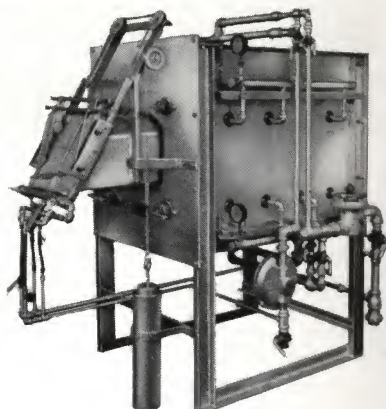
Furnace No.	Muffle Inside Dimensions			Length of Water Jacket	Max. Gas C.F.H. of 1050 B.T.U.	Max. Air C.F.M. at 16 oz. Pressure	Approximate Floor Space Dimensions
	Width	Height	Heated Length (For Available Length Deduct 2" to 4")				
68C	9"	2 1/2"	24"	36 1/2"	113	15	3'-6"W. 9'10 1/2"L.
68D	9"	2 1/2"	36"	45 1/2"	150	20	3'-6"W. 12'-10 1/2"L.
68E	9"	4"	36"	48"	190	25	3'-6"W. 12'-10 1/2"L.
92A	18"	8"	38"	72"	238	32	6'-6"W. 15'-3"L.
95	9"	2 1/2"	14"	23"	50	7	2'-10"W. 8'-6"L.
95A	6"	2"	14"	23"	50	7	2'-10"W. 8'-6"L.





# Controlled Atmosphere Muffle Furnaces

(Heat-Resisting  
Alloy Muffle)



Controlled Atmosphere Muffle Furnaces are used for clean hardening, annealing, carburizing, as well as for other general and atmosphere work.

These Muffle Furnaces are lined and burnered for operation at maximum temperatures ranging from 1850°F. to 2100°F., depending upon muffle size. General construction of these furnaces is similar to the Oven Furnaces described on pages 91-95.

A rear atmosphere gas inlet is provided. The sliding seal door and automatic curtain flame burner insure positive control of the atmosphere within the muffle at all times.

Muffle Furnace No.	Inside Muffle Dimen. (Approx.)				Standard Max. Temp. Deg. F.	Approx. Max. Gas Cons. C.F.H. 1050 B.T.U.	Approx. Air Req. C.F.M. at 16 oz. press.	Approx. Floor Space Dimensions
	Width	Side Height	Center Height	Available Length				
43	8"	6"	8"	12"	2100	150	25	48" x 47"
44	10"	8"	10"	18"	2100	175	30	50" x 53"
45	12"	8"	10"	24"	2100	200	34	52" x 59"
40	15"	10"	13"	30"	1850	260	44	55" x 65"
41	18"	12"	15"	36"	1850	305	51	58" x 84"
46	24"	14"	17"	45"	1850	400	67	65" x 96"

# "Bell Oven" Furnaces

(Patented)

These furnaces are designed to combine the convenience of the Oven Furnace with the characteristics of the Bell Furnace.

The alloy bell is linked to the door mechanism so that, as the door is opened, the bell rises from its sand seal on the hearth, permitting the operator to charge or discharge freely, while, when the door closes, the bell replaces itself to provide full muffle protection around the work.

The atmosphere inlet at the top of the bell permits the introduction of any desired atmosphere. The thermocouple is inside the bell and is so arranged that it is not directly affected by the flame temperature.

Lining, burning, etc., are all in conformity with our improved 200 series Oven Furnaces, see pages 91-94.

All kinds of atmosphere work may be done, including carburizing, nitriding, "Ni-Carbing," clean hardening and bright annealing and brazing. It may also be used for any other job which could be done in a regular Oven Furnace.

For cylindrical bell furnaces see pages 69-73.

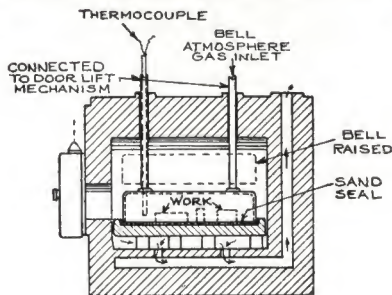
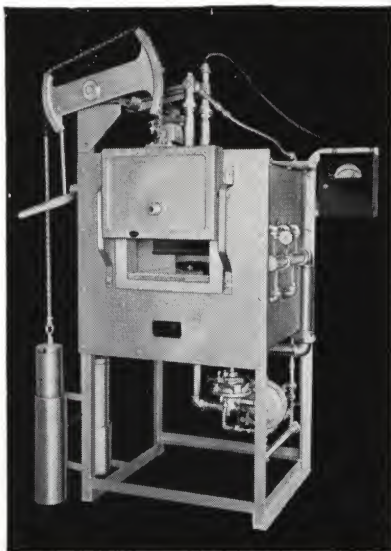
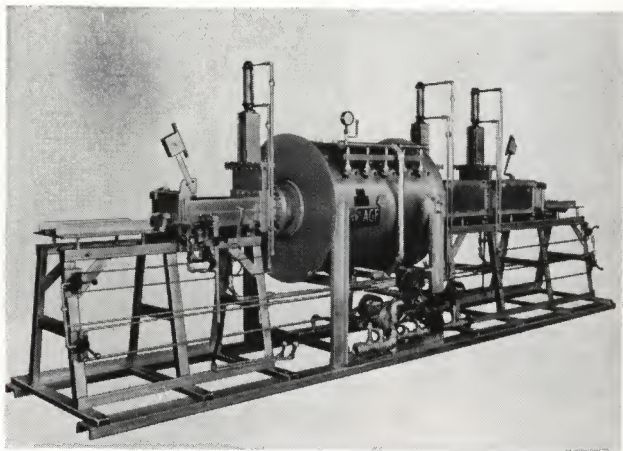


Diagram Section Through Furnace Showing Bell.

"Bell-Oven" Furnace No.	Bell Muffle Dimensions			Gas Con. 1050 B.t.u. Gas Cu F. per H.		Max. air Req. Cu. Ft. Per Min. at 16 oz. Pressure	Pipe Connections		Floor Space
	Width	Height	Length	Maximum	Holding at 1500°F.		Gas	Air	
200C	11 3/4"	4 1/4"	14 3/4"	125	30	25	1"	1 1/4"	40" x 54"
205E	11 3/4"	6 1/4"	23 1/2"	150	40	30	1"	1 1/2"	48" x 54"



## Controlled Atmosphere Brazing and Annealing Furnaces



Model 51 Push Through Muffle Furnace

A.G.F. Brazing and Annealing Furnaces are available in a standard range for operation at 1600°F. to 2100°F. for bright annealing, copper brazing and atmospheric hardening of regular and stainless steels using hydrogen or other atmospheres.

Extended range models for 1150° to 2100°F. operation are suitable for all operations described above and can additionally perform work such as silver soldering, annealing of both ferrous, non-ferrous and precious metals.

Cooling is accomplished fast enough in the water-jacketed extension to harden most air hardening types of stainless and high carbon, high chrome steels, while still under atmospheric protection.

### Flexibility.

Production heat treating departments can handle batch trays of various quantities of parts independently.

Construction features enable positive atmosphere control within the muffle in the heating chamber and cooling extension by means of the purge vestibules which are provided at the work entrance and the discharge end of the furnace.





## Simplicity.

A.G.F. Brazing and Annealing Furnaces have no wearing parts in the heat. The simplified combustion system using heat resisting alloy burners, the heavy duty lining construction, etc., reduce maintenance to a minimum.

After the heating cycle is completed, the work tray is pushed into the water-jacketed cooling muffle and thence into the discharge end vestibule where it is removed.

## CONSTRUCTION FEATURES

The purge vestibules, the heating chamber, water-jacketed cooling muffle, together with work tables at both ends are mounted onto common structural members insuring positive alignment of all parts.

## HEATING CHAMBER CONSTRUCTION

### Alloy Muffle.

The muffle is constructed of the best available heat resisting alloy, composition 60% nickel, 12% chromium, or better, to withstand operation at temperatures up to 2100°F.

### High Quality, High Efficiency Lining.

The lining comprises 4½" high grade insulating refractory backed up with block insulation.

### Combustion System.

The new A.G.F. Brazing and Annealing Furnaces, with either the standard or extended operating range are equipped with an air-gas pressure fired proportional combustion system. Maximum temperature uniformity is assured by the use of many burners firing into both sides of the amply sized combustion chamber, both above and below the muffle.

These furnaces are equipped with the A.G.F. simplified Single Valve Ratio Set Mixing Systems which employ Venturi action mixers. Air at a pressure of approximately 2 pounds per square inch is used to proportionately entrain fuel gas for proper combustion.

### Casing.

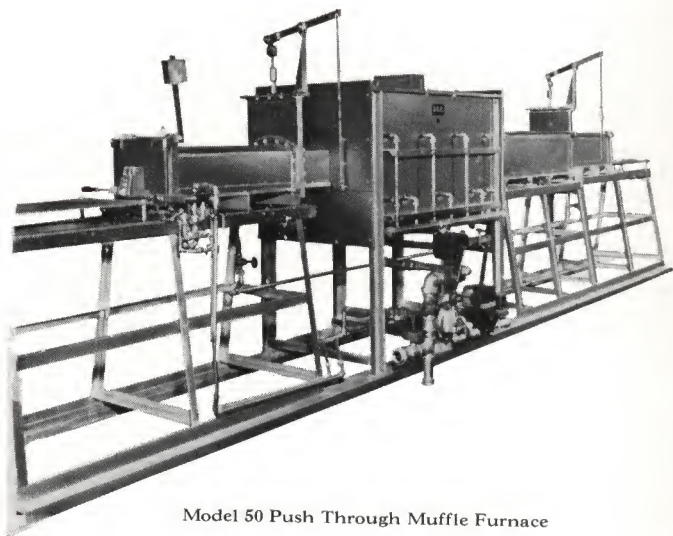
The furnace casing is constructed of welded steel plate suitably reinforced with structural members welded and bolted together.

## EXTENSION CONSTRUCTION

### Water-Jacketed Cooling Muffle.

The cooling muffle fabricated of stainless steel is flanged and bolted to the heating chamber muffle to achieve the best possible positive seal.

CYLINDRICAL  
FURNACES  
ALLOY  
FLOW  
THERMISTORS  
OVEN  
FURNACES  
POT  
FURNACES  
FORGES  
MELTERS  
TUBE  
FURNACES  
BURNERS  
BELL RETORT  
FURNACES  
AMMONIA  
DISSOCIATORS



Model 50 Push Through Muffle Furnace

### Automatic Curtain Flame Burners.

Stable air-gas curtain flame burners are provided at both entrances. These burners operate automatically when doors at either ends are open. Air-gas pilots are provided for the curtain burners and to ignite atmosphere gas venting out through the door openings.

### WORK BASKETS

The furnace is supplied with amply sized work conveying baskets, specially designed with runners for ease in operation and positioning. See tabulation on page 61 for size of work trays.

The charge and discharge end vestibules have counter balanced hinged doors, having a flapper for easy insertion of the tray push rod. Extension platforms are provided for positioning, loading and unloading of the work trays. Both the charge and discharge vestibules have sliding gates to insure positive atmosphere containment within the heating and cooling muffles.

### AMMONIA DISSOCIATOR

A suitably sized A.G.F. Ammonia Dissociator, complete with ammonia flow meter panel, can be supplied for use in conjunction with these furnaces.

# Brazing and Annealing Furnaces

Furnace Model No.	Approx. Entrance Height	Muffle Heated Length †	Work Baskets			Cooling, Water Jacketed Length, Muffle	Discharge, Charge and Discharge End Vestibule	Length, Charge and Discharge End Table	Max. Air Req., Cu. Ft./Min. at 1½ Lbs./sq. in.	\$Approx. Max. Gas Consumption, 1050 B.T.U./Nat. Gas, Cu. Ft./Hr.	Hydrogen Atmosphere Gas Req. Cu. Ft./Hr.
			Inside Width	Available Depth	Available Length						
48	6"	36"	7"	2"	15"	48"	32"	18"	60	360	150
50	8"	48"	10"	2"	24"	48"	34"	30"	80	480	260
51	6"	35"	7½"	4"	15"	24"	*24"	24"	42	255	175
52	4"	24"	3½"	2"	10"	24"	14"	12"	28	170	80
53	6"	40"	7½"	4"	20"	28"	*28"	28"	48	290	225

† In any muffle furnace, the openings of the muffle determines the percentage of total length that can be uniformly heated. End radiation losses reduce available heated length to approx. 60% of total heated length.

\*Discharge end vestibule is also water jacketed.

‡Depends upon application.







By Courtesy of Sirian Wire & Contact Co.

Making Metallic Tungsten Powder in a Tube Furnace. Temperatures must be controlled in zones for a definite cycle to obtain a satisfactory product.

## Rectangular and Cylindrical Tube Furnaces for . . .

Wire and Strip Annealing

Wire and Strip Hardening

Bright Annealing

Reducing Various Oxides and  
Salts to Powdered Metal

CYLINDRICAL  
FURNACES  
OVEN  
FURNACES  
POT  
FURNACES  
FORGES  
MELTERS  
TUBE  
FURNACES  
BELL RETORT  
FURNACES  
AMMONIA  
DISSOCIATORS







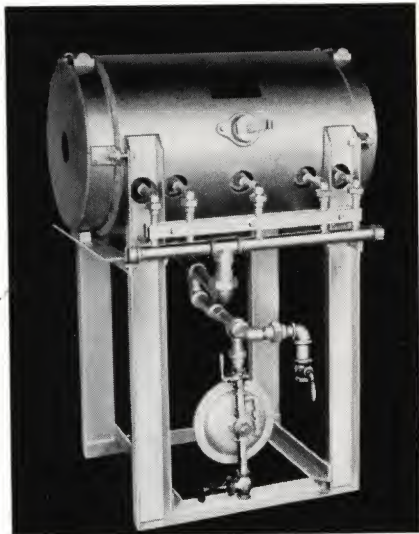
## Tube Furnaces

No. 71

Tube Furnace. Inside chamber length—29½". Will take a tube up to 3½" outside diameter.

Max. gas cons.—100 C.F.H.  
(1050 B.T.U. Gas).

Max. Air—16 C.F.M. at 16 oz.



THESE furnaces have been so named because in practically every case one or more tubes, through which work is passed, are heated in them. They find wide application.

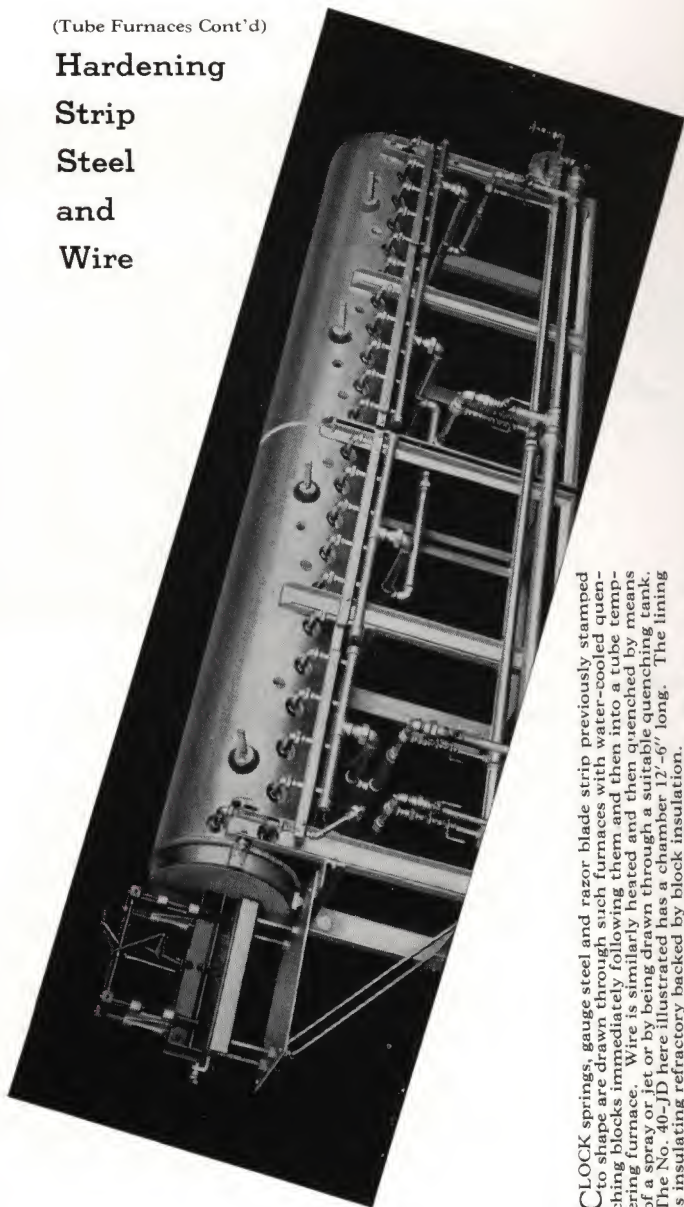
They are all of welded steel construction with a lining of insulating refractory backed by block insulation. Heat-resisting alloy burners fire into super refractory burner tunnels supporting combustion and protecting the surrounding brickwork. Our single valve ratio system provides the maximum flexibility in operation.

Tube Furnaces are supplied with one or more round, oval or rectangular tubes, either horizontal or inclined in practically any length.

In the single tube furnaces, the flame rotates around the tube to give extremely uniform heating. In multiple tube furnaces, the tubes are so spaced and burners so arranged as to obtain correspondingly uniform heating.

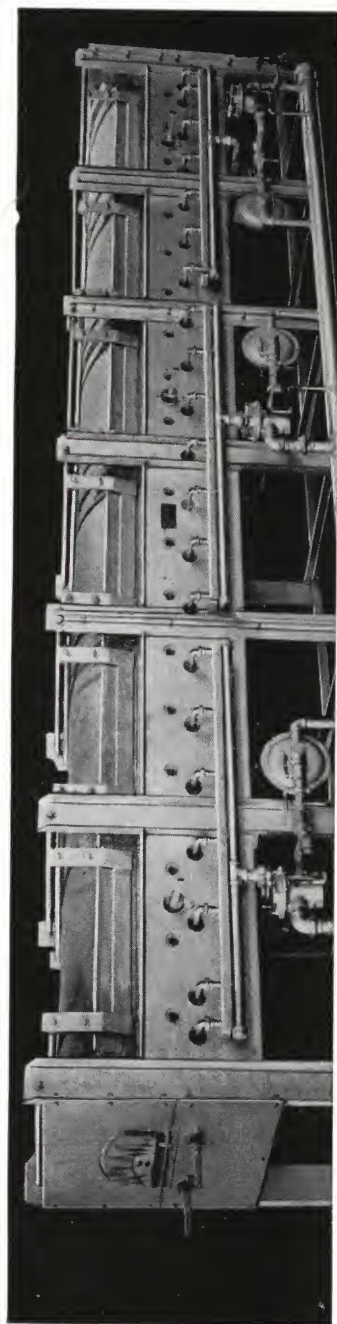
(Tube Furnaces Cont'd)

# Hardening Strip Steel and Wire



CLOCK springs, gauge steel and razor blade strip previously stamped to shape are drawn through such furnaces with water-cooled quenching blocks immediately following them and then into a tube tempering furnace. Wire is similarly heated and then quenched by means of a spray or jet or by being drawn through a suitable quenching tank. The No. 40-JD here illustrated has a chamber 12'-6" long. The lining is insulating refractory backed by block insulation.

Max. cons. (1050 B.T.U. Gas)—300 C.F.H. Max. air—50 C.F.M. at 16 oz.



(Tube Furnaces Cont'd)

## Annealing

FOR the annealing of brass and bronze wire strip, etc., tube furnaces are employed, the work being either drawn through a tube extension sealing into a quench or through a water-jacketed cooling extension. In some cases these furnaces are set at an angle.

## Réduction of Oxides, etc.

For the manufacture of metallic tungsten, molybdenum, etc., long Tube Furnaces are generally employed with a number of tubes through which boats containing the material to be reduced are pushed, the material being subjected to a reducing atmosphere under definite time-temperature conditions. An installation of this type is shown on the preceding index page.

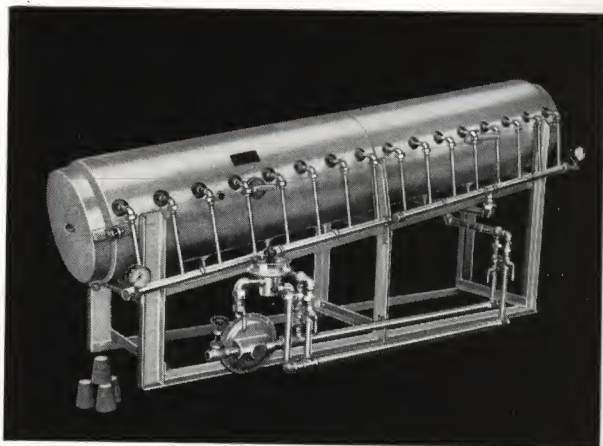
No. 72 Tube Furnace having a chamber length of 20'. It will take six tubes 2 1/2" inside diameter.

The entrance is reg. 2" high, max. 4" x 20" wide.

Max. air—85 C.F.M. at 16 oz.

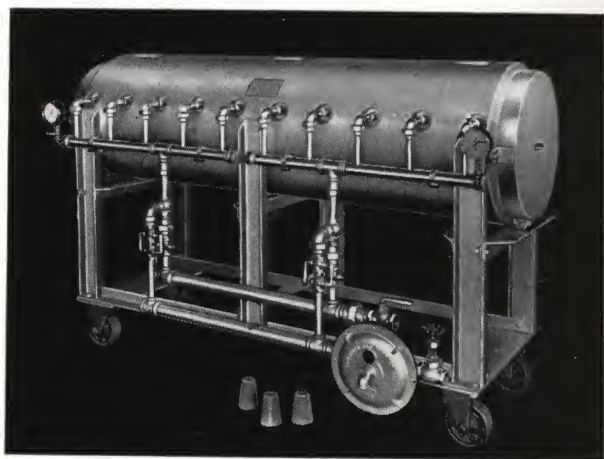
Max. cons. (1050 B.T.U. Gas)—500 C.F.H.





### No. 79 Tube Furnace

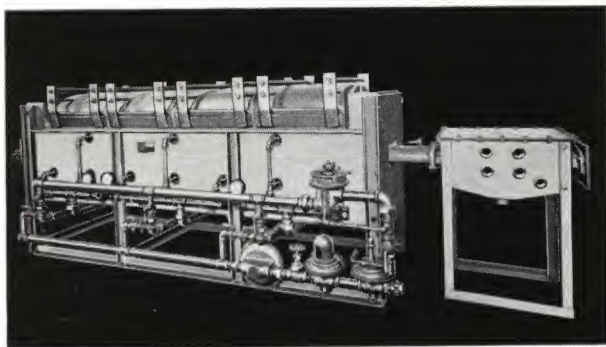
This furnace is designed for continuous annealing of non-ferrous strip or wire. The lower end is used as the discharge so that the end of the tube or muffle may be extended under the level of the quenching bath, thus forming a liquid seal for maintaining the atmosphere. The heating chamber is 9'-6" long and will take a tube up to 2½" high x 6" wide outside. The center height is 47⅛" at one end and 27½" at the other. Max. cons. of 1050 B.T.U. gas is 188 C.F.H. and max. air required is 30 C.F.M. at 16 oz. pressure.



### No. 80 Tube Furnace

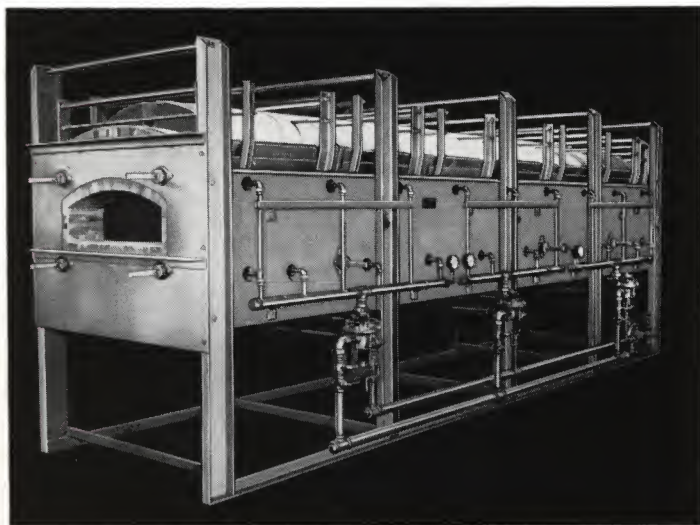
For heat treating work in a tube or muffle under special atmospheres. Casters may be supplied as illustrated to facilitate movement.

The heating chamber is 72" long and will take a tube up to 2½" high x 6" wide outside. The maximum gas consumption is 225 C.F.H. of 1050 B.T.U. gas and the maximum air required is 35 C.F.M. at 16 oz. pressure.



### No. 78 Tube Furnace

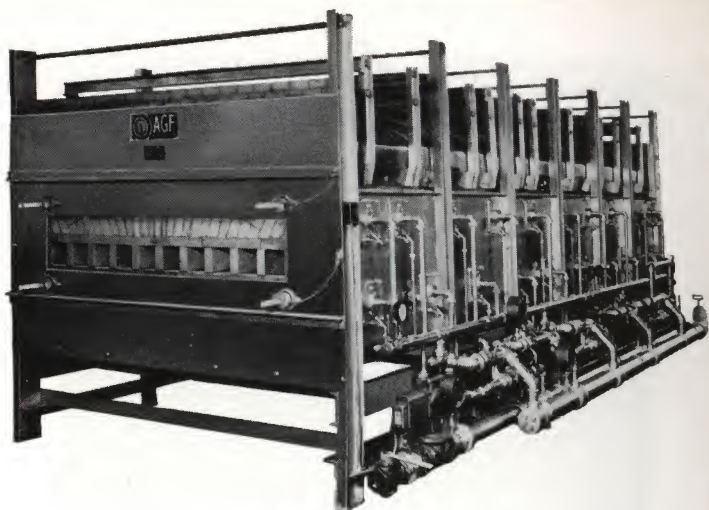
For the continuous heat treatment of strip up to approx. 10" wide with positive atmosphere control. A spray quenching unit, as illustrated, may be supplied for annealing brass, etc. The removable roof is in 4 sections. Chamber—8'-0" lg. Standard tube—12" wide x 1½" high inside. Maximum tube—13" wide x 4" high outside. Max. gas cons.—300 C.F.H. 1050 B.T.U. gas. Max. air—45 C.F.M. at 16 oz. pressure.



### No. 84 Tube Furnace

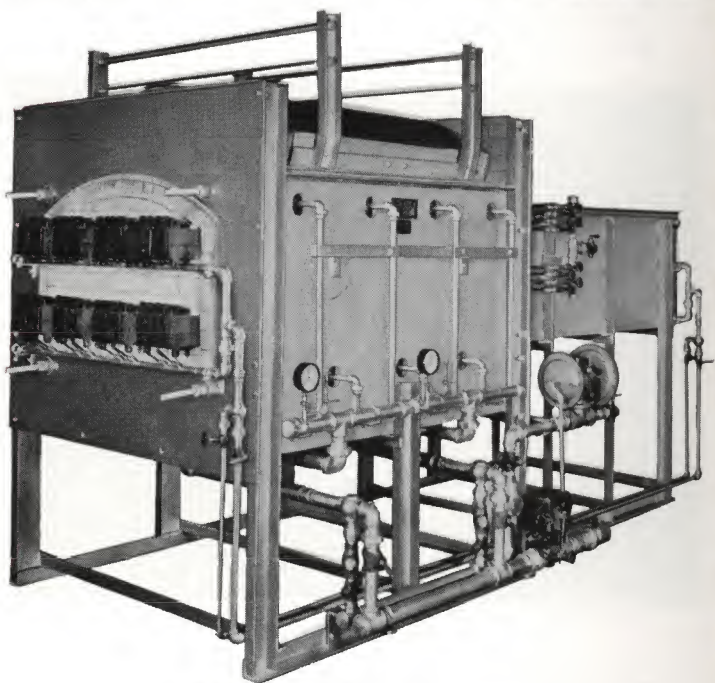
The furnace above and similar ones are used for the reduction of various metallic oxides such as tungsten, etc. Its usual application is for 19 tubes, 2¾" O.D. Max. entrance size—34" wide x 7½" high. Chamber 16'-6" lg. Max. gas cons.—500 C.F.H. 1050 B.T.U. gas. Max. air required—75 C.F.M. at 16 oz. pressure.





### Model 106-A Tube Furnace

The above furnace is suitable for use in the reduction of various metallic oxides, such as tungsten, molybdenum, etc. The furnace has a heated length of 17'6". The 5'6" wide entrance readily accommodates ten 4½" diameter muffle tubes. Piloted combustion blocks and zone construction permit maintenance of any desired temperature or temperature gradation from zone to zone.



### Model 108 Tube Furnace

The No. 108 Furnace was designed primarily for the atmosphere brazing of electrical contacts; however, this versatile furnace can also be used for reduction of oxides, annealing, etc. The heating chamber is 40" wide x 30" high x 48" heated length and accommodates a total of eight tubes, each tube approximately 5½" wide inside x 3" high. If desired a 60" long water cooling jacket can be furnished for the muffle tubes.





## Bell Retort Furnaces

For bright copper brazing  
of stainless steels,  
annealing, and other  
atmosphere work.

AMMONIA  
DISSOCIATORS

BELL RETORT  
FURNACES

BLOWPIPES &  
BURNERS

MELTERS

FORGES

POT  
FURNACES

OVEN  
FURNACES

CYLINDRICAL  
FURNACES  
AD.  
FLOW METERS





# Bell Retort Furnaces

No. 25 Bell Furnace

The bell with its base and charge may be removed from the furnace and cooled under atmosphere as pictured while another bell with work goes through its heating cycle within the furnace.



A.G.F. Bell Retort Furnaces permit completely controlled atmosphere processing at temperatures from 500°F. to 2150°F. These furnaces can be used for the following treatments without any modification whatsoever.

*Bright copper brazing* of stainless and regular steel parts.

*Nickel-chromium alloy brazing* of stainless steel materials at temperatures up to 2150°F.

*Hydrogen cleaning* or reduction of oxides on stainless steel materials to eliminate costly or delicate mechanical cleaning processes.

*Bright annealing* of alloy, ferrous and non-ferrous materials.

*Carburizing.*

*"Ni-Carb"* process of ammonia-gas case hardening.

*Nitriding.*

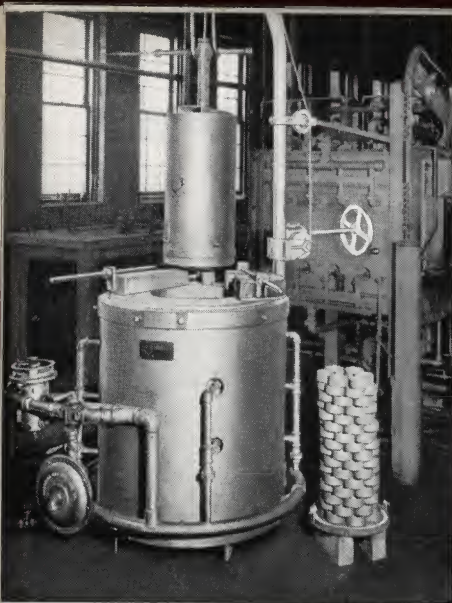
*Glass to metal sealing* of electronic components under atmosphere protection.

## OPERATIONAL ADVANTAGES

### Semi-continuous Operation

The use of multiple bell retorts provides semi-continuous operation. One bell retort containing work can be heated while another bell retort containing work can be cooled under atmosphere protection, while yet another is being loaded.





No. 24 Type Bell Furnace with charge.

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### Flexibility

Maximum flexibility is obtained by use of multiple and removable bell retorts. One charge of work can be nitrided, while the following charge in another bell retort can comprise stainless steel parts that are to be copper brazed or bright annealed in hydrogen atmosphere. Other processes such as "nickel chromium alloy" brazing, carburizing and ammonia-gas case hardening can also be easily accomplished in the same furnace. The use of

multiple removable bell retorts eliminates the need for cleaning, conditioning or decontaminating a fixed muffle before certain types of atmosphere work can be performed.

### Positive Atmosphere Control

The use of sealed alloy bell retorts, externally heated permits the attainment of extremely low dew point atmospheres for hydrogen brazing of stainless steels and other critical atmosphere work. A.G.F. Bell Retort Furnaces eliminate the possibility of atmosphere contamination resulting from moisture and oxygen absorption which can occur in furnaces having refractory lined atmosphere chambers.

### Uniformity

The use of many small burners having balanced heat inputs assures uniform heating of the bell retort and its work load. Tangential firing of the burners into the heating chamber eliminates direct flame impingement upon the retort. The resultant uniform heating assures consistent high quality results and long bell retort life.

### CONSTRUCTION FEATURES

A.G.F. Bell Retort Furnaces are built to withstand continuous operation at temperatures up to 2150°F. Quality construction features assure a long operating life with the minimum of maintenance.

### Bell Retorts

The A.G.F. bell retort assembly consists of three components, the bell, the base pan and the lifting frame as shown on the



No. 30-B Bell Furnace with loaded bell positioned in heating chamber. Bell assembly comprising lifting frame, base pan and bell is shown at right of illustration. The lifting frame and base pan is shown at the far left, with the bell standing alongside.

above illustration. These parts are fabricated of the best available heat resisting alloy, composition 60% nickel, 12% chromium or better. The bell is placed over the parts and is then sealed into the base pan in the lifting frame with a special sand.

The bell retort assembly is easily handled in and out of the furnace chamber by means of an over-head hoist.

### High Quality, High Efficiency Lining

The lining in A.G.F. Bell Retort Furnaces consists of high grade insulating refractory backed up with block insulation. The low heat storage and low heat loss of this lining construction insures fast heating up and more economical operation.

Super refractory burner tunnels are employed for long service life with minimum maintenance.

### Covers

To permit charging or removing the bell retort assembly, the smaller model bell retort furnaces are equipped with manually operated split type refractory covers which swing to either side. Larger model furnaces can be equipped with pneumatically or



hydraulically operated cover lifting mechanisms for lifting and swinging the refractory cover to one side.

### Casing

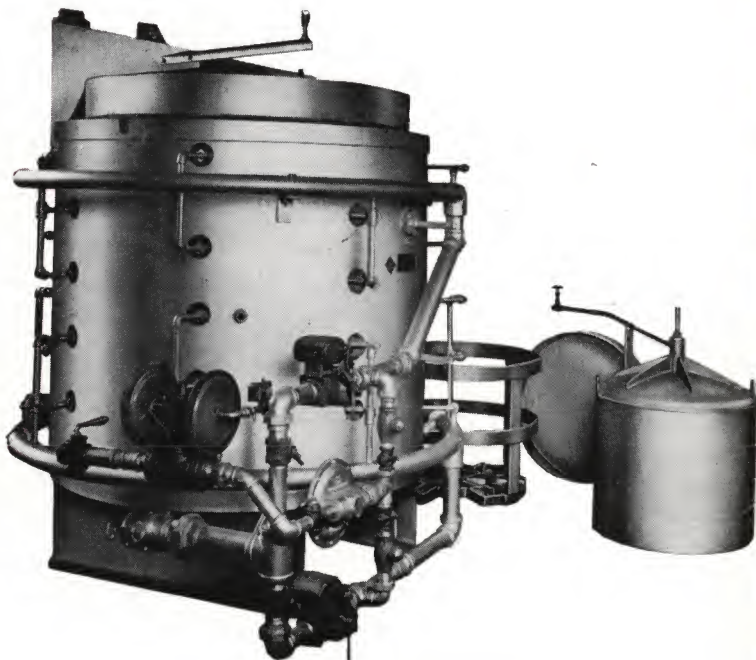
The furnace body is fabricated of heavy steel plate suitably reinforced. Suitable structural members are provided to support the furnace.

### Extended Range Operation

Where low temperature operation is desired, Bell Retort Furnaces can be equipped with a special extended range combustion which permits operation at temperatures as low as 500°F.

### INSTALLATION

A.G.F. Bell Retort Furnaces are suitable for either pit or floor level installation. The pit type installation is preferable for furnaces Model 30 and larger.

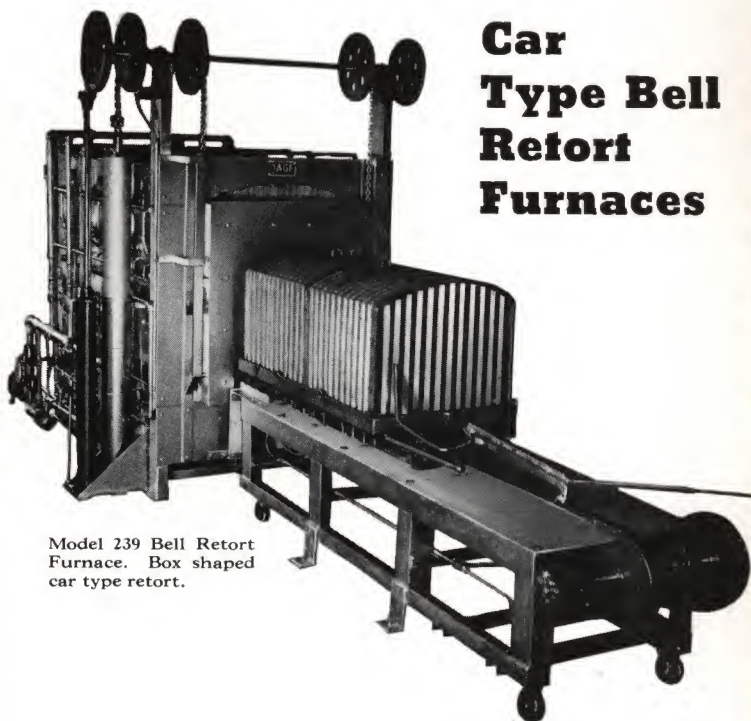


Model 88 Bell Retort Furnace.



# Bell Retort Furnaces

Bell Retort Furnace Model No.	Retort		Furnace Cover		Operating Data				Furnace Lining		Approx. Furnace Floor Space	Approximate Pit Dimensions		Estimated Net Weight, lbs.	Estimated Shipping Weight, lbs.
					Max Gas Consumption				Insulating Refractory	Block Insulation		Size	Depth		
	Diameter, Inside	Height, Available	Pneumatically Operated	Manually Operated	1050 B.T.U. Nat. Gas Cu. Ft./Hr.	B.T.U./Hr.	Max. Air Req. Cu. Ft./Min. at 1 1/2 lbs./sq./in.	Atmos. Hydrogen Cu. Ft./Hr. (Approx.)							
25B	4 3/4"	9"		X	77	80,900	13	15	2 1/2"	1 1/2"	2'-6" x 2'-6"	—	250	300	
24C	12"	21"		X	243	255,600	40	35	4 1/2"	2"	5'-6" x 5'-6"	—	1,900	2,200	
30B	15"	30"		X	344	360,800	57	45	4 1/2"	2 1/2"	5'-6" x 6'-0"	2'-0"	2,400	2,750	
78A	25"	48"	X		761	799,400	127	80	4 1/2"	4"	6'-6" x 7'-0"	4'-8"	8,000	8,500	
88	30"	24"	X		800	840,600	134	100	4 1/2"	4"	8'-0" x 9'-0"	4'-3"	7,500	8,000	
94	31 1/2"	35"	X		883	927,400	147	110	4 1/2"	4 1/2"	8'-0" x 10'-0"	3'-0"	8,000	8,800	
93	31 1/2"	42"	X		1,104	1,158,800	184	120	4 1/2"	4 1/2"	8'-0" x 10'-0"	4'-0"	8,500	9,200	



## **Car Type Bell Retort Furnaces**

Model 239 Bell Retort  
Furnace. Box shaped  
car type retort.

A.G.F. Car Type Bell Furnaces are designed to meet the need for large capacity batch type stainless processing . . . for handling unusually shaped pieces or heavy work loads.

Box shaped bell retort is rolled into and withdrawn from the furnace by means of a chain driven mechanism.

Bell Retort cover can be easily removed for loading and unloading.

Numerous small burners, firing from top, bottom and both sides of the heating chamber, assure uniform heating of the bell retort and work pieces.

Rapid and efficient heating is obtained because the bell retort is charged into a hot furnace.

Bell Retort can either be withdrawn from the furnace while at heat . . . or be slow cooled in the heating chamber.

Standard Size Bell Retorts are 3' wide x 6' long x 2'6" high.

Special sizes can be built.



## Ammonia Dissociators

AMMONIA  
DISSOCIATORS

FUR. BURNERS  
& S.V.C. SETS

BLOWPIPES &  
BURNERS

MELTERS

FORGES

POT  
FURNACES

OVEN  
FURNACES

CYLINDRICAL  
FURNACES  
AL  
FLOW METERS







# Ammonia Dissociators

(Low Pressure Operation)

A.G.F. has manufactured and supplied gas and ammonia dissociators with its controlled atmosphere furnaces since 1935. The construction of these dissociators is based on the experience gained in eighty years of furnace construction and over twenty years of experience in building dissociators.

Dissociated ammonia (75% hydrogen, 25% nitrogen) is an ideal atmosphere to use for the following treatments and processes:

- Bright brazing and annealing of stainless steels.
- Bright hardening of the hardenable stainless steels.
- Reducing oxides in the production of metal powders.
- Sintering parts compacted from metal powders.
- Bright annealing of various ferrous and non-ferrous alloys.
- As a carrier for other atmosphere gases or combinations of gases for special processes.



No. 3 Ammonia Dissociator

## ADVANTAGES

### Lower Cost

Dissociated ammonia is the lowest cost high hydrogen atmosphere available.

### Less Handling

The use of dissociated ammonia eliminates much of the attendant cylinder handling. A 150 pound ammonia cylinder yields 6750 cubic feet of dissociated ammonia, the equivalent of at least 26 cylinders of hydrogen. A bulk tank installation eliminates all cylinder handling.

### Simpler Operating Principle

A.G.F. Ammonia Dissociators do not employ heat exchangers or vaporizers. The A.G.F. low pressure system eliminates the difficulties experienced with other systems which require the maintenance of high tank vapor pressures.



## Easier to Pipe and Handle

A.G.F. Ammonia Dissociators operate with less than 3 p.s.i. of ammonia gas pressure, thus facilitating piping and control. The relatively low pressure employed is not subject to the possibilities of leakage in either the raw ammonia or dissociated ammonia lines which can occur in high pressure systems.

## Longer Catalyst Tube Life

The alloy catalyst tube which is fabricated of the best available heat-resisting alloy is operated at low gas pressures. The stressing of the catalyst tube caused by high pressure operation is eliminated, thus lengthening the operating life and permitting operation at higher temperatures to insure more complete dissociation.

## CONSTRUCTION

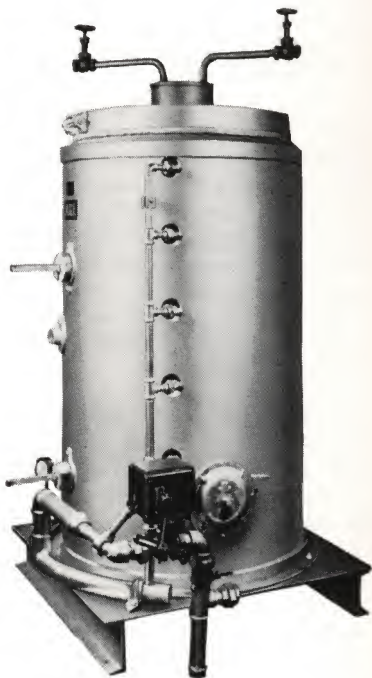
A.G.F. Ammonia Dissociators comprise a furnace or heating chamber into which is positioned a catalyst dissociator tube. The tube is heated to a controlled temperature of 1850°F. to 1900°F. to insure complete dissociation of the raw ammonia gas being passed through it.

## Catalyst Tube

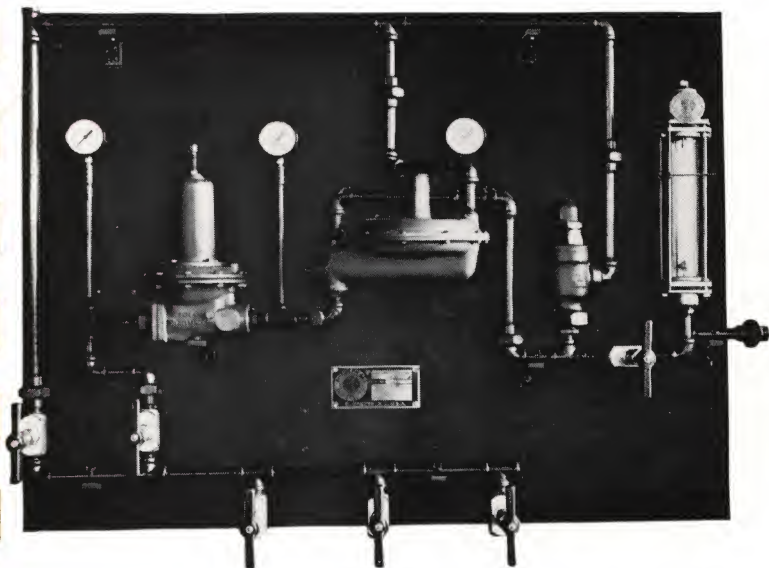
The catalyst dissociation tube is fabricated of the best available heat resisting alloy—60% nickel, 12% chromium or better. The 100 cu. ft./hr. capacity model employs a coiled tube dissociation unit, while the larger models employ specially designed alloy containers filled with a special catalyst.

## Combustion System

A.G.F. Ammonia Dissociators are equipped with an air-gas pressure fired proportional combustion system. Maximum temperature uniformity is assured by the use of many burners firing tangentially into the amply sized combustion chamber.







Ammonia Flow Control Panel

### Atmosphere Gas Inlet and Outlet

Inlet and outlet connections are at the top of the dissociator, thus making it easy to obtain tight connections quickly and facilitating inspection of the seals at the connections.

### AMMONIA FLOW CONTROL PANEL

An A.G.F. Ammonia Flow Control Panel illustrated above includes the necessary raw ammonia pressure regulators to achieve two stage reduction of the vapor pressure to below 2 p.s.i. before it passes into the dissociator tube. The necessary pressure relief valve, Flow Meters, shut off, and flow control valves are provided on the panel. The panel can either be floor or wall mounted. All piping, fittings, etc. are mounted on the face of the panel to facilitate connection, inspection and maintenance.

### DRYER

To achieve dewpoints as low as minus 80°F., suitable size activated alumina dryers are supplied.

# Ammonia Dissociators

Dissociator Model No.	Maximum Capacity Dissoc. Ammonia Cu. Ft./Hr.	Approx. Requirement Lbs./Hr. Raw Ammonia at Rated Capacity	Chamber Size	Dissociator Tube	Heating Chamber Operating Data				Pipe Connections				Approx. Floor Space
					Max. Air Required Cu. ft./min. @ 1½ p.s.i.	1050 B.T.U. Nat. Gas cu. ft./hr.	Max. Gas Consumption	Raw Ammonia	Dissoc. Ammonia	Fuel Gas	Air		
3	100	2.2	10½" dia. x 18" deep	Coiled alloy tubing	10	61	63,900	¾"	¾"	¾"	1"	2'-6" x 2'-6"	
2-A	200	4.4	15" dia. x 34" deep	Retort with catalyst 5¾" i.d. x 34" high	19	115	120,600	1"	1"	½"	1"	3'-10" x 3'-10"	
7-A	500	11.1	23" dia. x 53" deep	Annular retort, with catalyst, 4" i.d. x 9 ⅝" o.d. x 53" high	36	214	224,800	1"	1"	¾"	1¼"	4'-6" x 4'-6"	
7-C	750	16.7	23" dia. x 53" deep	Annular retort, with catalyst, 4" i.d. x 12" o.d. x 53" high	36	214	224,800	1"	1"	¾"	1¼"	4'-6" x 4'-6"	



Cylindrical Furnaces  
can be supplied in  
practically any size  
according to the  
nature of the  
requirement.

CYLINDRICAL  
FURNACES  
AL  
FLOW METERS

OVEN  
FURNACES

POT  
FURNACES

FORGES

MELTERS

BLOWPIPES &  
BURNERS

FUR. BURNERS  
& S.V.C. SETS

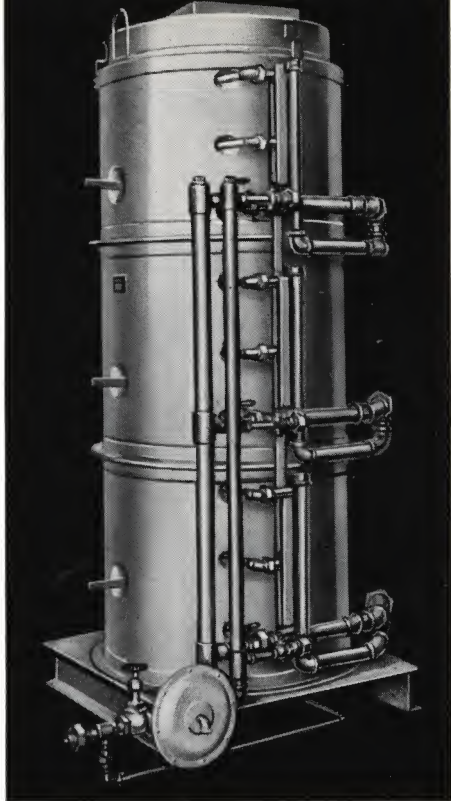
BLOWERS





# Cylin- drical Furnaces

No. 72 Cylindrical Furnace for hardening long taps and reamers made from high speed steel. The No. 73 is a companion furnace but designed for pre-heating. Both furnaces are equipped with a carborundum muffle 10" I.D., available length 6 ft.



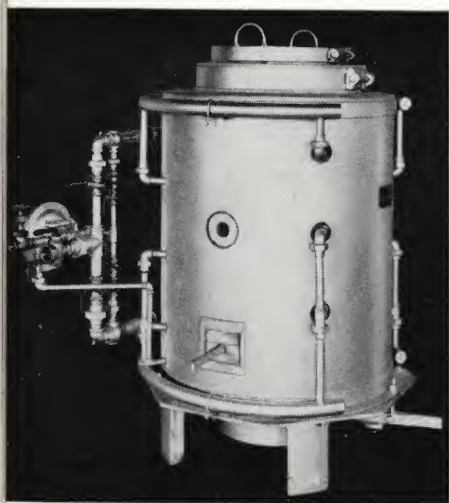
**V**ERTICAL Cylindrical Furnaces like the many other types of furnaces and heating machines are especially adapted for certain classes of work.

It is obvious that a round object may most readily be uniformly heated in a round furnace equipped with burners which fire tangentially. This type of furnace is thus well suited for the heating of vacuum retorts.

Likewise, long thin pieces can be most readily heated without warping and distortion if suspended in a Cylindrical Furnace. These units are therefore widely used either with or without a Muffle for the hardening of high speed hack saw blades, for hardening drills, taps and reamers of carbon and high speed steel, especially the longer ones.

The furnace bodies of the Bell Retort Furnaces and Vertical Gas Carburizers are standard designs which can be adapted for use as Cylindrical Furnaces.

For special application these Cylindrical Furnaces can be mounted on the horizontal.



## Cylindrical Furnaces

No. 74 Cylindrical Furnace designed especially for hardening high speed hack saws, with carborundum muffle 11" I. D. and available height adequate for hardening 30" power saws.

THE furnace illustrated was designed and built especially for hardening high speed steel hack saws and is used by a number of concerns especially for this work.

Its tangential burners are subdivided into an upper and lower section so that they can be controlled separately to make up for the high radiation losses at the top which occur because the furnace is opened frequently. The gas input is high to attain a quick rise to operating temperature from cold and when charging. This makes larger production capacities possible.

A gas connection is provided for feeding raw gas into the muffle to give a reducing atmosphere when desired.

A removable recessed bottom brick receives the excess borax, a coating of which is generally employed when hardening molybdenum high speed saws.

Many other sizes of Cylindrical Furnaces are also available to take a pot for annealing, spheroidizing, etc., and for special applications such as the processing of gases in a closed retort which must be externally heated.





## Diamond Block Method For High Speed Steel

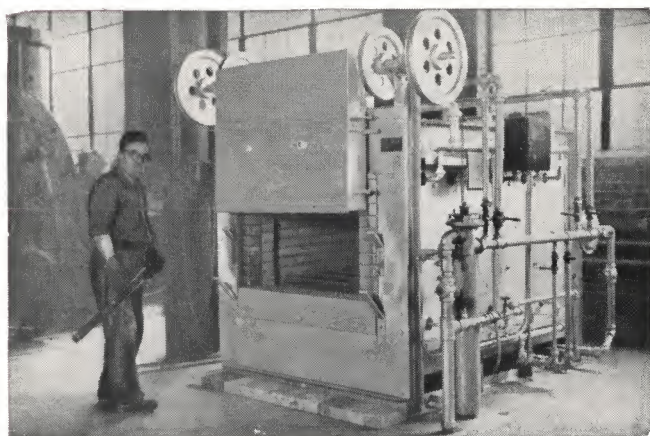
### Furnace Table

### Tool Room Furnace

### Improved Oven Furnaces

### Improved Large Ovens

### Double Entrance Furnaces



Large Oven Furnace with Automatic Temperature Control in the  
Research Laboratory of a well known company.

At least a pyrometer, if not automatic temperature control, is recommended on all Oven Furnaces.

ACCESSORIES &  
FLOW METERS

OVEN  
FURNACES  
DUAL TEMPERATURE

POT  
FURNACES

FORGES

MELTERS

BLOWPIPES &  
BURNERS

FUR. BURNERS  
& S.V.C. SETS

BLOWERS





## Diamond Block Method of Hardening High Speed Steel—Atmospheric Control Produces Clean Hardening

No Scale—No Decarburization

No Reduction in Size

*Diamond Blocks* are recommended for the hardening of all high speed steels. They are muffles composed of a carbonaceous compound which gradually generates a gas to produce an atmosphere between carburization and decarburization when heated in a furnace at about 1800° to 2300°F. This atmosphere is constantly correct and control does not depend on continual analysis and manipulation.

*Quality Tools.* Tools retain their initial sharp clean cut edges with no scale, decarburization or reduction in size and have a maximum hardness and excellent grain structure from the center to the external edge of the tool.

*The Time Element* is not so critical and tools can be given an ample soaking period to assure maximum hardness. Tools have been heated for more than one hour at 2350°F. without change in size or surface conditions to indicate this excessive heating time.

*Proper Size Diamond Blocks* should be selected in accordance with the size tools to be heat treated, and not the size furnace used. Only a reasonably small clearance around the tool is allowed.

*Molybdenum* high speed steels, also high carbon high chromium steels, when hardened in Diamond Block Atmosphere are completely free from decarburization or scale. These types of steel are recognized as especially subject to decarburization, which makes the assured quality of the Diamond Block Method of hardening especially desirable.

*The Silicon Carbide Muffle*, in which the Diamond Blocks are inserted, protects the Block and increases its life by preventing the outside from wasting away.





## No. 89E High Speed with Carborundum Muffle and Diamond Block



This unit constitutes the least expensive we ever supplied for quality hardening of high speed steel. It is equipped with a carborundum muffle having inside dimensions as follows: Width,  $4\frac{3}{8}$ "; height,  $1\frac{1}{2}$ "; depth, 6"; which accommodates the No. 2 Diamond Block, having inside dimensions as follows: Width,  $3\frac{5}{8}$ "; height,  $1\frac{5}{16}$ "; heated depth  $6\frac{1}{2}$ ".

With it is used the No. 2 tray. When it is in position;

Clearance height is  $\frac{3}{4}$ ".

Width between ribs,  $2\frac{7}{8}$ "

Available depth, 5".

As an Oven Furnace:—See page 109.

As a Forge:—See page 109.

### General Specifications:

Heating time—25 minutes to 2350°F.

Maximum gas (1050 B.t.u.)—120 cubic feet per hour (126,000 B.t.u.'s).

Maximum air at 16 oz. pressure—17 cubic feet per minute.

Connections—City Gas  $\frac{1}{2}$ ", Natural Gas  $\frac{3}{8}$ ", Bottled Gas  $\frac{1}{4}$ ".

Bench space—26" x 16".

Gross weight—150 pounds.



# No. 96F High Speed Furnace

## As a Semi-Muffle Furnace

When supplied as a semi-muffle furnace, it is provided with a carborundum hearth slab. The entrance is 5" x 5" and the hearth length is 10". Gas consumption, etc., are as given in the tabulation at the bottom of the page.

## For Diamond Block Hardening

The carborundum muffle is pushed through the back and the hearth slab is omitted; consequently, it cannot be used as a semi-muffle furnace. In addition to the Diamond Block sizes listed below, smaller blocks can be used with a cover plate, sizes being as follows:

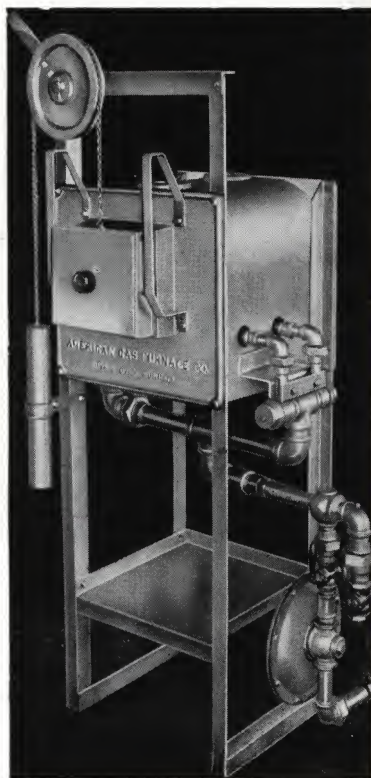
### INSIDE DIMENSIONS

No.	Width	Height	Depth
2	3 <sup>5</sup> / <sub>8</sub> "	15 <sup>1</sup> / <sub>16</sub> "	6 <sup>1</sup> / <sub>2</sub> "
3	3 <sup>1</sup> / <sub>2</sub> "	15 <sup>5</sup> / <sub>16</sub> "	7 <sup>1</sup> / <sub>2</sub> "
3 <sup>1</sup> / <sub>2</sub>	3 <sup>1</sup> / <sub>2</sub> "	2 <sup>1</sup> / <sub>4</sub> "	8 <sup>1</sup> / <sub>2</sub> "

Cover plate for No. 2 or No. 3, 4 <sup>3</sup>/<sub>8</sub>" wide by <sup>1</sup>/<sub>4</sub>" thick by 7 <sup>3</sup>/<sub>4</sub>" long.

Tray for same 6 <sup>1</sup>/<sub>2</sub>" long by <sup>5</sup>/<sub>16</sub>" thick by 2 <sup>7</sup>/<sub>8</sub>" width between the ribs.

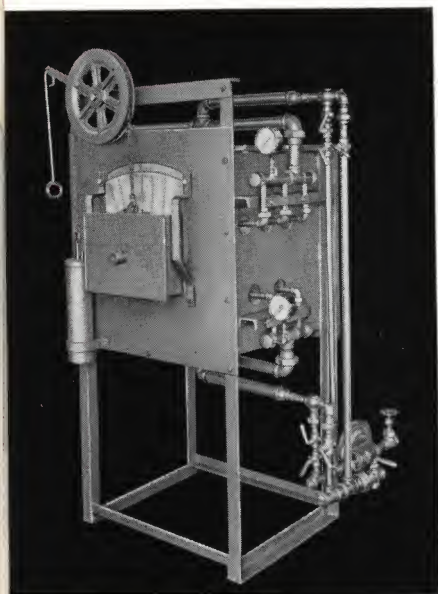
The muffle is sealed into the furnace entrance and consequently the products of combustion cannot enter it. The muffle itself is closed by the sliding door. Wasting away of the diamond block is thus prevented. This unit may also be used as a regular muffle furnace with diamond blocks removed.



Furnace No.	Carborundum Muffle Inside Dim. in Inches			Diamond Block No. 4 Inside Dim. in Inches			Height from Floor to Entrance	Time to Heat to 2400°F.—Hrs.	Gas Con. 1050 B.T.U. Gas Cu. F. per H.		Max. Air Req. Cu. ft. per min. at 16 oz. pressure
	Width	Height	Length	Width	Height	Length			Maximum	Holding at 2400°F.	
96F	4 <sup>3</sup> / <sub>8</sub>	4	11	3 <sup>1</sup> / <sub>2</sub>	3 <sup>1</sup> / <sub>2</sub>	9 <sup>1</sup> / <sub>2</sub>	42	1	165	60	20



## No.150-BB High Speed Furnace



This illustration is typical of either our No. 150-BB with hearth slab as a semi-muffle furnace or with full Carborundum Muffle and diamond block. The description below applies primarily to the furnace with diamond block.

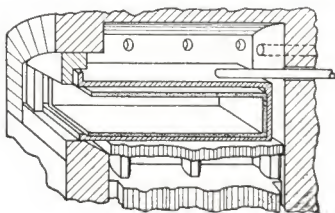
When supplied with a hearth slab—see detailed dimensions, etc., in the tabulation on the succeeding page—it may be operated with a rich atmosphere for hardening Tungsten high speed steel or for hardening other grades, providing grinding is subsequently done or that the work is coated with a suitable material to prevent decarburization or scaling.

In this furnace are combined the advantages of A.G.F. improved design and construction and the simplicity of the Diamond Block method for obtaining quality results in the hardening of high speed steel.

Extreme flexibility is obtained:

- (a) Numerous combinations of Diamond Blocks can be worked out to best fit the particular work and obtain clean hardening without decarburization and with maximum production.
- (b) The Diamond Block can be omitted where the work pieces are too large to be handled in it. In this case, pieces of Diamond Block can be placed adjacent to the work and, by using the baffle in the front of the muffle, the results obtained approximate those which can be secured when using the standard Diamond Block.
- (c) The furnace may be used as a regular semi-muffle high speed Oven Furnace without the Diamond Block or muffle. Good results are obtained when operating in this manner on 18-4-1 grades of high speed steel and on the molybdenum grades where grinding is permissible after hardening.

Sectional view of furnace with carborundum muffle and Diamond Block. Tray and baffle are not shown. Note proper location of thermocouple.





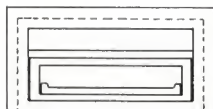
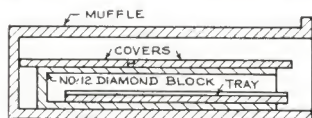


**Carborundum Muffle.** The carborundum muffle is positioned through the entrance of the furnace and is supported by our standard hearth slab. Suitable bricks are provided to seal the muffle off from the combustion chamber.

Inside dimensions of the muffle are as follows:

Width,  $8\frac{7}{8}$ "; height,  $4\frac{1}{16}$ "; depth 16".

**Available Height.** The inside height of the Diamond Block less the thickness of the tray gives the actual inside working height. The thickness of the tray varies with different sizes from  $\frac{3}{16}$ " to approximately  $\frac{1}{2}$ ".



The arrangement shown immediately above applies when using the following sizes of Diamond Blocks:

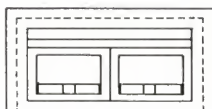
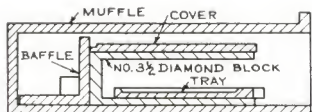
#### INSIDE DIMENSIONS

No.	Width	Height	Length
11	$7\frac{13}{16}$ "	$1\frac{5}{16}$ "	$11\frac{1}{2}$ "
12	$7\frac{13}{16}$ "	$1\frac{11}{16}$ "	$12\frac{1}{2}$ "
13	$7\frac{13}{16}$ "	$2\frac{3}{8}$ "	$13\frac{1}{2}$ "
14*	$7\frac{13}{16}$ "	$3\frac{1}{16}$ "	$14\frac{1}{2}$ "

\*No cover plate required.

Cover Plate No. 3Y, Width  $8\frac{3}{4}$ ", Length 15".

Tray No. 14, Width  $7\frac{1}{2}$ ", Length 12".



Above arrangement permits the use of two Diamond Blocks side by side. Two of any of the following sizes can be so used:

#### INSIDE DIMENSIONS

No.	Width	Height	Depth	
			Std.	'A' Length
2	$3\frac{5}{8}$ "	$1\frac{5}{16}$ "	$6\frac{1}{2}$ "	$13\frac{1}{2}$ "
3	$3\frac{1}{2}$ "	$1\frac{5}{16}$ "	$7\frac{1}{2}$ "	$14\frac{1}{2}$ "
$3\frac{1}{2}$	$3\frac{1}{2}$ "	$2\frac{1}{8}$ "	$8\frac{1}{2}$ "	$15\frac{1}{2}$ "
4	$3\frac{1}{2}$ "	$3\frac{1}{8}$ "	$9\frac{1}{2}$ "	$15\frac{1}{2}$ "

The 'A' length blocks have exactly the same cross section as the regular blocks but are longer. The number should be used with the letter suffix 'A' when ordering.

Cover plates same as above.

Baffle No. 3YB is designed to closely fill the full opening of the carborundum muffle.

Furnace No.	Oven Dimensions				Height from Floor to Entrance	Time to Heat to 2400°F.—Hrs.	Gas. Cons. 1050 B.T.U. Gas. Cu. F. per H.		Max. Air Req. Cu. Ft. Per Min. at 16 oz. Pressure	Floor Space in Inches
	Entrance Inches		Hearth in Inches				Maximum	Holding at 2400°F.		
	Width	Height	Width	Length						
150BB	12	5	12	14	42	2	200	65	30	38 x 46



## Furnace Table

**F**OR the small shop, laboratory, vocational school, high schools, colleges and universities, this table is unusually well adapted because of the variety of work for which it can be used.

As many as four students can work at it simultaneously as it is so designed that students can work from both sides.

The clean lines of this modern table and the ample storage space under it insure a pleasing, orderly appearance at all times.

The gas valves and air cocks for both furnaces are conveniently located just inside the door.

### Forging and Heat Treating

The No. 89-D Forge described on page 109 can be used as a heat treating oven or as a forge.

### Lead Hardening, Cyanide Hardening, Salt Bath Hardening and Tempering

A pressed steel pot, 6" in diameter by 8" deep, is suitable for any of these operations. If more than one of them is to be performed, we recommend extra pots.

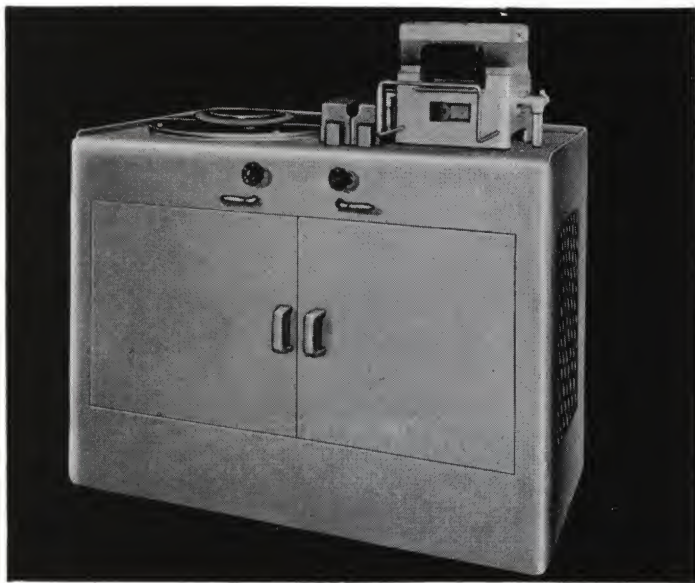
### Making Aluminum Castings

Small castings of aluminum are becoming increasingly popular because of their permanence and the comparatively low temperature at which strong, sound castings can be made. Such castings machine readily.

For this work the pressed steel pot is removed and a cast iron crucible, having a capacity of 12 pounds of aluminum, is used. A crucible, refractory crucible support, and cover with bail are supplied as part of the standard unit. A No. 8 Graphite crucible may also be used.

Furnace is lined with insulating refractory for efficiency and is equipped with heat-resisting alloy burners firing tangent to the pot for long life.

A lighting hole is conveniently located. Venturi Mixers make adjustment of the air and gas from the connections on the front of the table easy.



## Furnace Table

(continued from preceding page)

### Air Supply

Spencer blower No. B-50-12 (see page 164) operating from the 110 volt, 60 cycle, single phase lighting circuit is permanently mounted under the table and connected direct to the furnaces.

#### Specifications

Forge: See page 108

Pot Furnace:

- Pressed steel pot, 6" dia. by 8" deep.
- Cast iron crucible, 4 1/2" dia. by 7" deep.
- Capacity, 12 pounds of aluminum.

Table:

- Totally enclosed with hinged doors in the front and a large removable plate at the rear for inspection, repairs, etc.
- Floor space, 48" x 24".
- Height, 36".
- Connections, gas 1".
- Electricity, 110 volts, 60 cycle, single phase.
- Maximum gas, 1050 B.T.U. Natural gas, 150 cu. ft./hr.
- Net weight, 700 pounds.
- Shipping weight, 850 pounds.

If supplied without blower the air connection is 1 1/2"; maximum air requirement, 30 cu. ft. per min. at 16 oz. pressure.





## **Tool Room Oven Furnaces**

The A.G.F. Model No. 16 and 16-FC Oven Furnaces are specifically designed for use in the tool department or small plant where occasional tools and parts must be heat treated. These furnaces are also extensively used for production hardening of small work pieces.

The No. 16-F Oven Furnace employs a standard combustion system with the burners mounted into the side wall of the heating chamber to achieve positive control of the furnace atmosphere. The No. 16-F has an operating range between 1200° and 1800°F. and can be used for hardening, annealing, tempering, pack hardening or carburizing of small parts.

The No. 16-FC is equipped with a special combustion system employing external burners which at the sacrifice of some degree of atmosphere control permits the achievement of an operating range from 300° to 2300°F. The No. 16-FC is particularly well suited to the clean hardening method utilizing a heat resisting alloy tray described on page 90.

The No. 146 Oven Furnace is the No. 16-F made double length.

### **OPERATIONAL ADVANTAGES**

Quick heating up is economically achieved by the use of a high efficiency lining and a high efficiency combustion system. Operating temperature of 1500°F. is achieved in approximately 25 minutes.

Minimized maintenance and long operating life is assured by the use of heavy duty, high quality construction.

Superior control of combustion. Burner flames can be easily adjusted to maintain a neutral, reducing or oxidizing atmosphere in the furnace chamber surrounding the work.

### **CONSTRUCTION FEATURES**

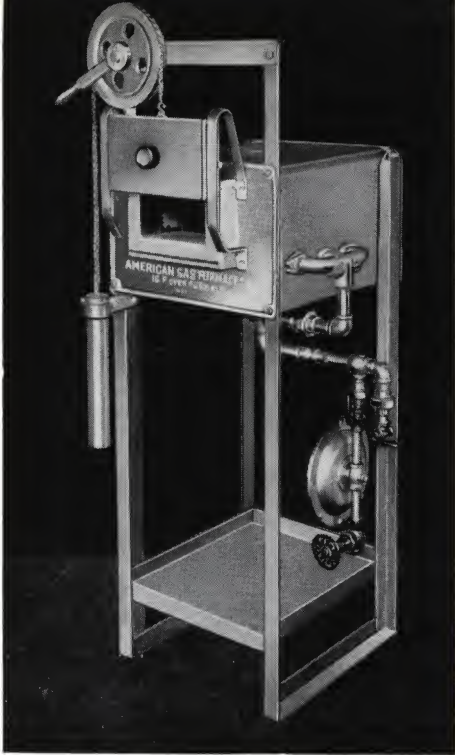
Casing is fabricated of welded steel plate and angles, with removable cast iron front and back plates. A convenient shelf

is provided in the bottom of the leg frame to accommodate tongs, tools, etc. High efficiency lining is moulded and pre-burned high grade, light weight insulating refractory.

Counter balanced refractory door is easily operated and is self-sealing. A special observation window is provided in the door.

Burnering is designed to achieve maximum temperature uniformity. Three tips fire into each side of the heating chamber from staggered positions and the heat input capacity of each tip is sized according to its location, thus providing uniform heating of the work hearth area.

Single Valve Ratio Set combustion system employs venturi action mixer utilizing air at 1 to 2 pounds per square inch



Oven Furnace No.	Operating Temperature Range	Entrance		Hearth Slab		Height from Floor to Entrance	Max. Air Req. Cu. Ft./Min. at 1 lb./sq. in.	1050 B.T.U. Nat. Gas Cu. Ft./Hr.	Supply Conn. Pipe Size		Floor Space
		Height	Width	Available Width	Length				Air	Fuel Gas	
16-F	1200° To 1800°F.	4"	8"	8"	14"	41 1/2"	13	78	3/4"	3/8"	28" x 30"
16-FC	300° To 2300°F.	4"	8"	8"	14"	41 1/2"	13	78	3/4"	3/8"	28" x 30"
146	1200° To 1800°F	4"	8"	8"	28"	41 1/2"	26	155	1"	3/4"	28" x 60"



pressure to proportionately entrain the fuel gas for fast, efficient heating. Once the air to fuel gas ratio is set, no further adjustments are necessary.

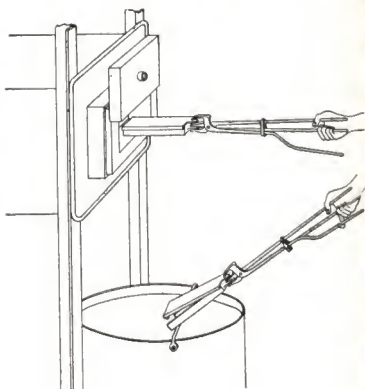
## CLEAN HARDENING OF SMALL PARTS

Heat-resisting alloy tray with cover can be supplied when specified for the clean hardening of parts such as small needles, pen points, shafts, surgical knives, etc.

A small quantity of charcoal, carburizing compound or bone can be placed with the work in the tray when it is desired to prevent any trace of decarburization or to case-harden the work to a slight degree.

When using the alloy tray with cover, the usual practice is to first heat it to temperature. The work pieces are arranged on another unheated, open-ended light sheet metal tray. After the alloy tray has been heated, it is removed from the furnace. The cover of the alloy tray is then removed and the work is quickly slid from the light sheet metal tray into position on the hot alloy tray.

Removal of the alloy tray and the quenching operation are shown in the illustration. The cover of the alloy tray is not opened until the tray and work is positioned over the quench. Special three-lever tongs are supplied for use in conjunction with these trays. Two of the levers support and hold the tray, while the third lever opens and closes the cover.





# Improved Oven Furnaces

A.G.F. Oven Furnaces are engineered to withstand the severe and continuous service to which these furnaces are subjected in commercial heat treating plants. The construction features afford many operational advantages which assist the operator in producing high quality work. These furnaces are extensively used for the hardening of carbon and alloy steels, annealing, tempering, pack hardening of carbon and alloy steels, pack carburizing, etc.

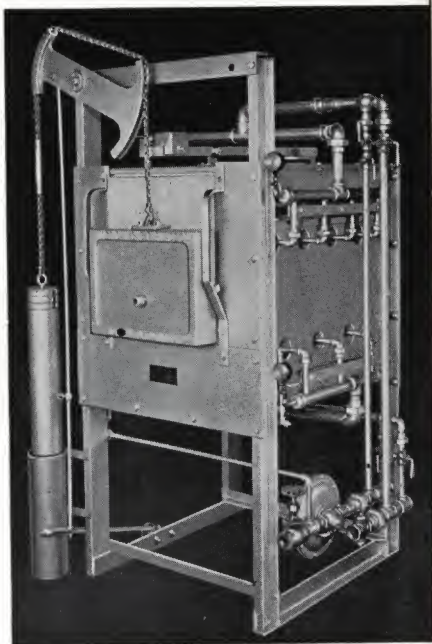
The main heating burners fire immediately under the arch from both sides of the heating chamber. The hot gases from the burner flames are trapped beneath the arched roof of the oven chamber and descend evenly around the work and hearth, giving up their heat. These products of combustion are then forced out through vents which are located under the floor of the heating chamber and which exhaust at the roof through a duct in the back wall.

The lower burners are of a supplementary nature and fire between the floor of the furnace and the hearth slab upon which the work is placed. The function of the lower burners which also fire from both sides of the heating chamber is to assure a uniform balance of temperature.

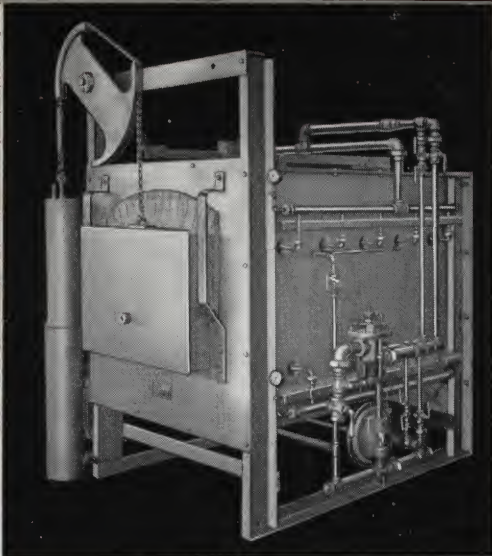
Since all of the products of combustion must vent under the hearth slab and through the floor and back wall of the furnace, a positive pressure is built up within the oven furnace chamber. This positive pressure precludes the infiltration of air into the oven, even when the door is not tightly closed. The chimney action normally experienced in top vented oven furnaces is eliminated.

The A.G.F. Single Valve Ratio Set combustion system employs a proportional venturi-action mixer. The burner flames can be easily adjusted to maintain a neutral, reducing or oxidizing atmosphere surrounding the work in the oven throughout the entire operating range, that is, from high to low temperature. The adjustment of the burner flames is easily made by one simple adjustment of the A.G.F. Single Valve Ratio Set. No operational adjustments need to be made unless a change is desired in the furnace atmosphere conditions.

The features described above in effect produce a muffle type furnace in which any desired atmosphere condition can be



No. 205B Oven Furnace



No. 220 Oven Furnace

maintained during the heat treating cycle.

## OPERATIONAL ADVANTAGES

Atmosphere control is achieved by adjusting the flame setting of the heating burners. The construction of the heating chamber and of the combustion system permits more positive control of atmosphere within the oven than

is possible with ordinary topvented furnaces or those employing a bunsen firing system.

Excellent uniformity of temperature is achieved by the use of many small burners firing both top and bottom from both sides of the heating chamber. The use of numerous small burners rather than a few larger burners as is the common practice provides a better heat distribution—the furnace comes up to temperature more quickly and evenly. Further, the capacity of each burner is sized according to its location in the furnace chamber—slightly larger capacity burners being used near the door opening where heat losses are the greatest.

The upper and lower burners are arranged in separate and independent sets so that the furnace can be easily balanced out for temperature uniformity under particular operating conditions.

Economical operation and quick heating-up is achieved by the use of a high efficiency lining which has low heat storage and low heat loss factors. The gas consumption of the latest style A.G.F. Oven Furnaces with insulating refractory linings is approximately 50% less than that of older style furnaces employing a fireclay lining.

Quiet operation results from the use of many small burners rather than a fewer number of larger and noisier burners. The combustion chamber and vent construction are designed to produce a quiescent atmosphere within the oven.

Minimized maintenance and long operating life is assured by the use of heavy duty construction features such as high quality lining, super refractory burner tunnels, heat-resisting alloy burners, etc.

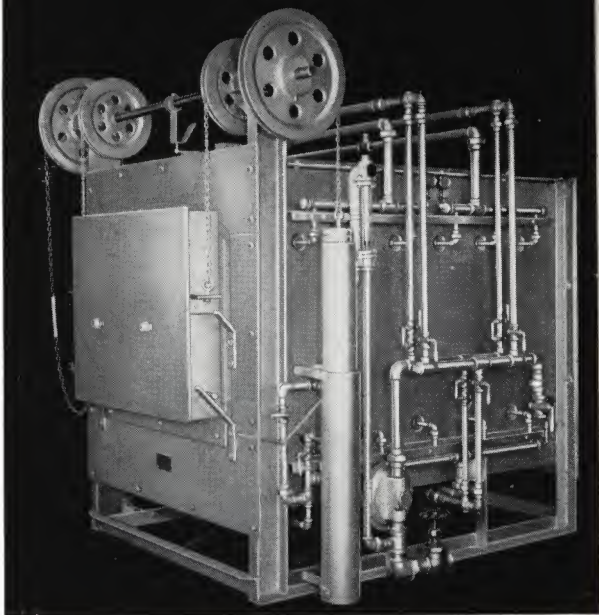
## CONSTRUCTION FEATURES

Lining comprises  $4\frac{1}{2}$ " of high grade insulating refractory backed by  $2\frac{1}{2}$ " of block insulation.

Hearth slab. The hearth slab upon which the work pieces rest and the hearth slab supports are of super refractory which we



No.  
225C  
Oven  
Furnace



have found most desirable from the standpoint of life, resistance to abrasion, spalling, cracking and also because of its good thermal conductivity.

Counter-balanced door is easily operated. The door is lined with insulating refractory and is provided with an observation hole having a Pyrex glass window.

Models No. 200, 205 and 210 are provided with a foot treadle device for raising the furnace door.

If desired, any of the standard Oven Furnaces can be equipped with an air cylinder having a foot operated valve to raise and lower the door and to operate with customer's high pressure air supply.

Casing is constructed of welded steel plate suitably reinforced with structural members welded and bolted together.

Heat-resisting alloy burners are employed on all models to give long service life and minimized maintenance. Alloy burners are not subject to oxidation and corrosion which clogs up cast iron burner tips normally used on such furnaces.

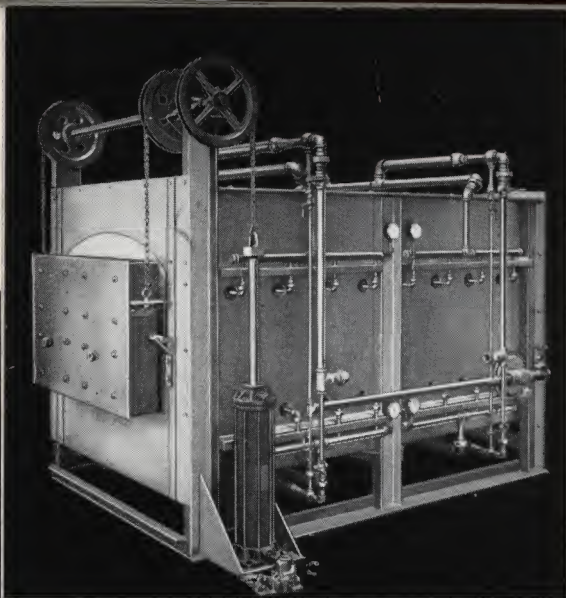
Single Valve Ratio Set combustion system employs venturi-action mixers using air at one pound per square inch pressure to proportionately entrain the fuel gas for fast and efficient heating.

Manifold pressure gauge having a large dial face is supplied for each set of upper and lower burners to give a quick visual indication of operating conditions.

## OPTIONAL FEATURES

**Over-hearths.** Heat resisting alloy over-hearth extending into the furnace entrance vestibule and equipped with side flanges can be supplied at an additional charge to facilitate sliding





No.  
232  
Oven  
Furnace

heavy work pieces or carburizing boxes in and out of the chamber.

*For high temperature operation up to 2500°F.* the furnace can be equipped with a silicon carbide over-hearth.

*Automatic vent closures and atmosphere adjusting burners.* The vent openings are closed the instant the door is raised, thus forcing all of the products of combustion out through the door and preventing the air from infiltrating into the oven chamber. This feature assists in obtaining scale-free work.

When vent closures are supplied the furnace is also equipped with atmosphere adjusting burners which introduce unburned gas immediately under the main heating burners at the top of the furnace. The function of these burners is to permit setting the main burners for the most efficient heating and then employing the atmosphere adjusting burners to enrich the atmosphere to maintain a reducing condition within the oven chamber which is suitable for the hardening of various grades of carbon and high speed tool steels.

## STANDARD OPERATING TEMPERATURES

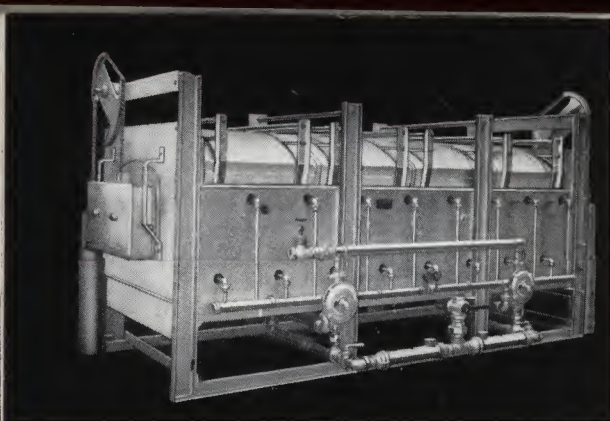
A.G.F. Oven Furnaces are supplied for operation at temperatures from 1300° to 1800°F. Lower temperatures can be maintained in the standard furnaces by operating with either the upper or lower set of burners. If desired, A.G.F. furnaces can be supplied for lower operating temperature ranges as specified by the user.

## HIGH TEMPERATURE OPERATION

For special applications any of the standard A.G.F. Oven Furnaces can be lined and burnered for operation at temperatures up to 2500°F.

# Improved Oven Furnaces

Oven Furnace No.	Entrance		Heart h		Lining		Standard Maximum Temp., Deg. Fahr.	Gas Consumption 1050 B.T.U. Nat. Gas Cu. Ft./Hr.		Max. Air Required Cu. Ft./Min at 16 oz. Pressure	Supply Connections		Number of Burners		Floor Space	Approximate Shipping weight, lbs.
	Width	Height	Width	Length	Height from Floor to Entrance	Insulating Refractory	Insulation				Air	Gas	Upper	Lower		
201	12"	5"	12"	14"	42"	4 1/2"	2 1/2"	1800	100	25	1 1/2"	1"	6	4	36" x 50"	1,600
200	16"	8"	16"	19"	42"	4 1/2"	2 1/2"	1800	125	30	1 1/2"	1"	6	4	40" x 54"	2,250
205B	16"	10"	16"	28"	42"	4 1/2"	2 1/2"	1800	150	40	1 1/2"	1"	8	6	48" x 54"	2,700
206	16"	16"	16"	28"	42"	4 1/2"	2 1/2"	1800	200	43	1 1/2"	1"	8	6	50" x 54"	2,900
210	16"	10"	16"	42"	32"	4 1/2"	2 1/2"	1800	215	45	1 1/2"	1"	8	6	54" x 62"	3,160
212	16"	10"	16"	65"	32"	4 1/2"	2 1/2"	1800	250	65	1 1/2"	1 1/4"	12	8	55" x 84"	4,050
215A	26"	16"	26"	36"	40"	4 1/2"	2 1/2"	1800	250	60	1 1/2"	1 1/4"	8	6	65" x 66"	5,100
220	26"	16"	26"	48"	30"	4 1/2"	2 1/2"	1800	265	75	2 1/2"	1 1/4"	10	8	65" x 76"	5,700
225C	36"	24"	36"	60"	30"	4 1/2"	2 1/2"	1800	450	115	2 1/2"	1 1/4"	12	10	93" x 94"	8,400
230	36"	24"	36"	72"	30"	4 1/2"	2 1/2"	1800	500	125	2 1/2"	1 1/4"	14	12	80" x 106"	9,500
226	36"	24"	36"	78"	36"	4 1/2"	2 1/2"	1800	500	125	2 1/2"	1 1/4"	10	8	82" x 110"	9,850
231	42"	42"	42"	48"	30"	4 1/2"	2 1/2"	1800	525	150	2 1/2"	1 1/4"	10	8	86" x 78"	10,300
235	42"	42"	42"	84"	30"	4 1/2"	2 1/2"	1800	800	200	3 1/2"	1 1/2"	16	16	88" x 118"	14,000
232	42"	18"	42"	85"	30"	4 1/2"	2 1/2"	1800	500	125	2 1/2"	1 1/4"	16	16	90" x 120"	13,200
238	49"	24"	49"	96"	24"	4 1/2"	2 1/2"	1800	915	230	3 1/2"	2 1/4"	18	18	95" x 130"	17,100



Model  
77T  
Double  
Entrance  
Furnace  
with  
Removable  
Roof

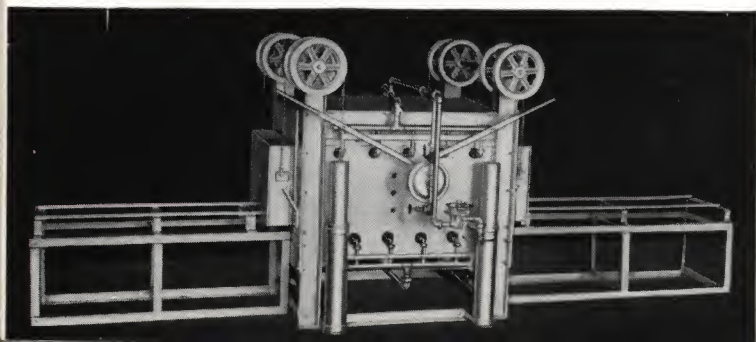
## Double Entrance Ovens

For semi-continuous operation, that is, charging at one end and discharging at the other, these furnaces prove advantageous, for example, in the annealing of cups, long tubes, etc. The general construction is similar to the standard Oven Furnaces in that they are top and bottom fired, lined with insulating refractory, equipped with heat-resisting alloy burners and the Single Valve Ratio Set combustion system.

Of course, other sizes of furnaces as described on preceding pages can be similarly arranged if so desired.

Double Entrance Oven Furnace No.	Entrance		Hearth		Height from Floor to Entrance	Time to Heat to 1500°F.—Hours	Standard maximum Temp. Deg. Fahr.	Maximum Consumption, 1050 B.T.U. Nat. Gas Cu. Ft./Hr.	Max. Air Required Cu. Ft./Min. at 10 oz. Pressure	Floor Space
	Width	Height	Width	Length						
210C 145	16 1/2" 18"	12" 10"	14" 18"	42" 10' 10"	32" 38"	1 1	1800 1800	225 340	30 46	55" x 68" 56" x 142"
137A 221	26" 26"	16" 16"	26" 26"	48" 60"	40" 30"	1 1	1800 1800	250 325	34 44	65" x 82" 64" x 94"
215B 77T	26 1/2" 32"	26" 10"	26" 36"	37 1/2" 12' 0"	40" 36 1/2"	1 2	1800 2000	250 600	34 81	58" x 70" 86" x 180"
234 237	36" 48"	24" 48"	36" 48"	48" 60"	30" 30"	2 2	1800 1800	500 675	67 92	86" x 86" 95" x 94"

No. 137A Double Entrance Oven Furnace, with tracks, which is suitable for annealing brass, etc. The work is placed in suitable baskets on trucks and pushed through the furnace.







## Improved Pot Furnaces for . . .

Lead Hardening  
Cyanide Hardening  
Salt Bath Hardening  
Liquid Carburizing  
Tempering  
Non-Ferrous Annealing and  
Solution Heat Treatment

### Rectangular Pot Furnaces

Typical Installation of a Large Salt Bath Hardening Pot.  
Automatic temperature control is provided, although it  
cannot be seen in this illustration.



ACCESSORIES &  
FLOW METERS

USEFUL DATA

POT  
FURNACES

FORGES

MELTERS

BLOWPIPES &  
BURNERS

FUR. BURNERS  
& S.V.C. SETS

BLOWERS





## No. 12C Pot Hardening Furnace



12C Pot Furnace

A versatile, compact gas-fired bench style pot type hardening and tempering furnace which can also be used as a melting furnace, see page 118.

With a pressed steel pot, the furnace can be used for salt hardening, lead hardening or tempering at temperatures up to 1800°F.

Rugged and durable construction features include:

*Heat resisting alloy burners* (two) firing tangentially into heating chamber.

*High quality, hard burned fireclay lining.*

*Heavy sheet steel furnace body.*

*Pot supporting ring* is provided to uniformly distribute weight of pot and contents on a greater surface area of the supporting brick, thus prolonging lining life.

*Venturi-action mixing system* using 12 ounces air pressure for low temperature operation and 24 ounces air for high temperature.

*Lighting hole with refractory plug.*

### *Specifications:*

For various salt tempering and hardening operations, the furnace is equipped with a pressed steel pot 6" in diameter x 5" deep.

*Chamber Size:* 8" diameter x 7½" available depth.

*Maximum Air Requirement:* Approximately 7 cu. ft./min. at one pound per square inch.

*Maximum Gas Consumption:*  
40,000 B.T.U./hour.

*Connections:* Air—¾"; Gas—⅜".

*Bench Space:* 20" x 24".

*Net Weight*—approximately 120 pounds.

*Shipping Weight*—approximately 150 pounds.





## Pot Tempering Furnaces

A.G.F. Pot Tempering Furnaces are designed for the tempering of both carbon and high speed tool steels with either oil or salts at temperatures from 350° to 1100°F. The liquid heating medium excludes air, thus assuring clean work without scaling or extreme discoloration. Heating in a liquid medium also assures that all work parts are heated to the same temperature.

The casing is of all welded sheet steel construction and is lined with a light weight insulating material which reduces heat storage to a point where it is negligible, thus eliminating temperature over-riding difficulties. The pot is of cast semi-steel and is provided with lifting eyes. A drip ring prevents getting the heating medium in the furnace chamber.

Uniform heating is assured by a special ring type burner, which is easily removed for inspection or cleaning, and a properly designed venting system.

These furnaces are supplied either to use air at one pound and gas at line pressure with our Single Valve Ratio Set or to use only an atmospheric or Bunsen type mixer. When supplied with the atmospheric mixer, the maximum temperature is 900°F., and an inexpensive throttling automatic temperature controller may be used.

With the S. V. R. Set the air-gas mixture is set as desired and automatically maintained. Control of heat input is by manipulating the air cock only.

When supplied with an atmospheric or Bunsen type mixer a pilot flame is provided so that the burner can be shut off entirely when necessary to prevent over-riding of the temperature and it is automatically relighted by the pilot when heat is called for by the control.

No. 4 Tempering Furnace

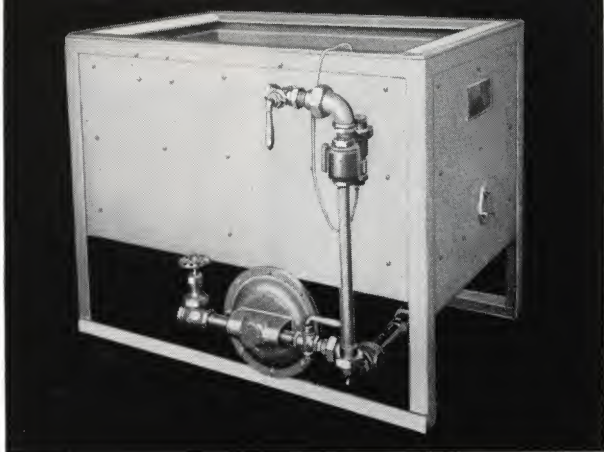


No. 4

Pot 11" diameter x 10 1/2" deep  
Mesh wire basket 7" dia. x 7" deep  
Max. air at 16 oz. 4 cu. ft./min.  
Max. gas (1050 B.T.U.) 30 cu. ft./hr.  
Connections Gas, 3/8"; Air, 1/2"  
Floor space 26" x 32"  
Net weight 340 lbs.  
Gross weight 400 lbs.

No. 7-D

Pot 17 1/4" dia. x 17 3/4" deep  
Mesh wire basket 11 1/2" dia. x 14" deep  
Max. air at 16 oz. 7 cu. ft./min.  
Max. gas (1050 B.T.U.) 55 cu. ft./hr.  
Connections Gas, 1/2"; Air, 3/4"  
Floor space 30" x 36"  
Net weight 450 lbs.  
Gross weight 600 lbs.



No. 30C Rectangular Pot Tempering Furnace with single valve ratio set and Partlow throttling type automatic temperature control in air line. (Max. Temp. 950°F.)

## Rectangular Pot Tempering Furnaces

These furnaces are designed for use with oil or salt as a medium in tempering or stress relief operations at temperatures from 350°F. to 950°F. and for occasional use in tempering high speed steel at temperatures to 1100°F. They are intended primarily for longer pieces of work which would not fit well in a round pot, however, they are suitable for a wide variety of shapes and sizes. Because the heating medium is liquid, oxygen is excluded, resulting in clean work without scale or excessive discoloration. Also, all parts of the work are brought up to temperature at the same time, minimizing distortion.

### CONSTRUCTION

The body of the furnace is of all welded steel plate and angle construction suitably reinforced at strategic points for greater strength. The cast semi-steel pot hangs by its flange in the ample combustion chamber. At this point, the design is such that drippings of oil or salt are prevented from entering the chamber. A covered observation and lighting hole is also provided.

A mesh wire basket as listed in the table below is supplied with each furnace.

These furnaces are provided with a single valve ratio set as per page 158 using air at 1 to 2 lbs. pressure and gas at 2"-8" water column pressure.

Furnace Number	Size of Pot			Inside Dimensions of Basket			Max. Gas (1050 B.T.U.) Cu. Ft. per Hr.	Max. Air Cu. Ft./Min. at 16-oz. Pressure
	Length	Width	Depth	Length	Width	Depth		
17A	19 1/2"	10"	7"	14 1/2"	8"	5"	63	9
30C	23 1/2"	15"	11 1/2"	18 1/2"	10"	8"	78	11
31C	29"	15"	12 1/2"	24"	10"	8"	95	13



No. 315A Pot Furnace

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## **Pot Hardening Furnaces**

A.G.F. Pot Hardening Furnaces are supplied in various sizes to suit the requirements of the small shop heat treating department or for continuous duty in the production heat treating department or a commercial heat treating plant.

A.G.F. Pot Hardening Furnaces are regularly supplied for use with lead, cyanide, neutral salt or carburizing salt as the heating medium.

### **OPERATIONAL ADVANTAGES**

Uniformity of heating is achieved by the use of many small burners firing into the heating chamber. The use of numerous small burners equally spaced apart rather than a few larger burners as is the common practice provides a better heat distribution—the pot comes up to temperature more quickly and is more evenly heated.

Tangential firing of the burners into the furnace chamber imparts a swirling action to the flames and products of combustion, thus eliminating direct flame impingement upon the pot.

Quiet operation results from the use of many small burners rather than a fewer number of larger and noisier burners.

Down Draft. The products of combustion vent through a refractory lined flue at the bottom of the furnace chamber, thus insuring most efficient utilization of the available heat and a maximum supply of heat to the top of the pot where the radiation losses are the greatest.

Top firing insures melting of the contents of the pot from the top downward thus avoiding the setting up of undue strains in the pot during the heating-up period.

Economical operation and quick heating-up is achieved by the use of a high efficiency lining which has low heat storage and low heat loss factors. Gas consumption of latest style A.G.F. Pot Furnaces with insulating refractory linings is approximately 50% less than that of furnaces employing fireclay linings.

Minimized maintenance and long operating life is assured by



the use of heavy duty construction features such as high quality lining, super refractory burner tunnels, heat-resisting alloy burners, etc.

## CONSTRUCTION FEATURES

**Lining.** The side wall of the furnace chamber is built of high grade insulating refractory backed up with block insulation. For mechanical strength a hard burned refractory is employed at the top of the heating chamber. The bottom of the furnace is lined with a high grade refractory material and slopes downward to a combined drain-out and vent.

Super refractory burner tunnels are used in all models to provide a long operating life under the most severe operating conditions.

Heavy sheet steel furnace body is ruggedly constructed for long life. The two piece cast iron top plate used on A.G.F. Furnaces eliminates the possibility of cracking which is experienced with one piece top plates.

Pot supporting ring with tight sealing arrangement is supplied to prevent the drippage or spillage of salts or other contents of the pot from entering the furnace heating chamber.

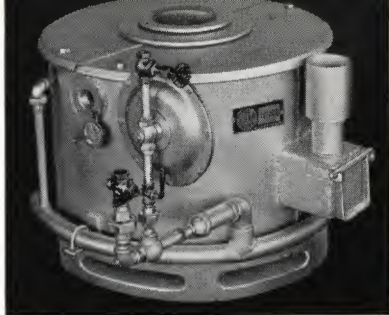
Side venting through the wall of the furnace and through a lined flue near the bottom of the furnace chamber directs the flue gases away from the operator. Warpage and cracking of the top plate resulting from venting around it is eliminated.

Vent and drain-out. The products of combustion escape at the bottom of the furnace through the combination vent and drain-out shown at the right side of the illustration of the Model 300 Pot Furnace. The products of combustion entrain atmospheric air before passing into the flue, thereby reducing their temperature and preventing excessive oxidation or corrosion of the flue. A flap door keeps the drain out opening closed.

Heat-resisting alloy burners are employed on all models to give long service life and minimized maintenance.

Single Valve Ratio Set combustion system employs venturi action mixers using air at approximately one pound per square inch pressure to proportionately entrain the fuel gas for fast and efficient heating. This combustion system provides A.G.F. Pot Furnaces with the wide turn down range necessary for rapid heating as well as the ability to hold the desired temperature.

Manifold pressure gauge having a large dial face is supplied on the mixture manifold to give a quick visual indication of operating conditions.



No. 300A Pot Hardening Furnace, note arrangement and completeness of drain-out and bottom vent.



## POTS

The pot sizes listed for every model are the maximum size which can be used in the furnace. Pots of smaller diameter or lesser depth can be used in any of the furnaces with excellent results.

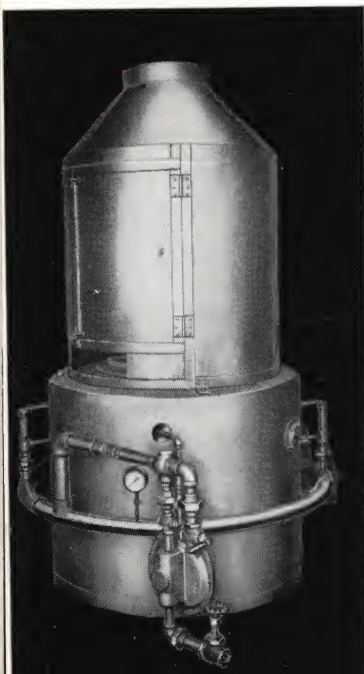
Pots for the Model 360 Pot Furnace can be supplied only in cast heat-resisting alloy. Pots for all other models can be supplied in any of the following materials at an additional cost.

Pot Type	Pot Material
(A)	Pressed Steel.
(B)	Pressed Steel, exterior coated with chromium-nickel.
(C)	35% nickel, 15% chromium heat resisting alloy.
(D)	60% nickel, 12% chromium heat resisting alloy.
(E)	Fabricated Inconel.

## OPTIONAL FEATURES

**Hoods.** Any of the pot furnace models listed can be supplied with a suitable hood for carrying off fumes. These hoods are made of

No. 340A Pot Furnace  
Equipped with hood.



heavy gauge sheet steel with a large vent in the conical top for connecting to an exhaust system. An opening between the top of the furnace and the bottom of the hood facilitates ventilation—chimney action drawing fumes out of the hood. Large double doors make access to the pot easy, either for handling work or for rotating or removing the pot. The notch under the door is convenient for the long handles on baskets or bars on which work is generally handled.

## STANDARD OPERATING TEMPERATURES

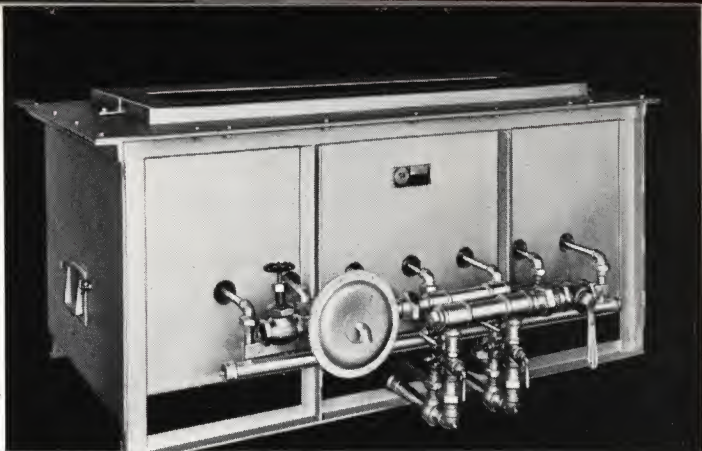
A.G.F. Pot Furnaces are supplied for operation at temperatures from 1400° to 1650°F. If desired, these furnaces can be supplied for lower or higher operating temperatures as specified by the user.

# Pot Hardening Furnaces

Pot Furnace Model No.	Pot Size		Capacity of Pot		Height from Floor to Top of Pot	Lining		Gas Consumption, 1050 B.T.U. Nat. Gas		Max. Air Required Cu. Ft./Min. at 16 oz. Pressure	Number of Burners	Supply Connections Pipe Sizes		Floor Space	Approximate Net Weight, Lbs.	Approximate Shipping Weight, Lbs.	Approximate Shipping Measure
	Diameter	Depth	Salt Lbs.	Lead Lbs.		Insulating Refractory	Insulation	Maximum Holding	Cu. Ft./Hr.			Air	Gas				
300A	6"	10"	13	95	24 1/2"	4 1/2"	1 1/2"	63	15	10	2	3/4"	1 1/2"	34" x 38"	600	750	36" x 39" x 33"
305A	8"	12"	27	205	24 1/2"	4 1/2"	1 1/2"	88	20	14	4	3/4"	1 1/2"	34" x 38"	600	750	36" x 39" x 33"
310A	12"	16"	87	650	29"	4 1/2"	2 1/2"	150	28	24	4	1 1/4"	3/4"	47" x 52"	950	1,200	48" x 44" x 38"
315A	14"	18"	135	1,000	34"	4 1/2"	2 1/2"	175	33	28	8	1 1/4"	1"	47" x 52"	1,100	1,400	48" x 50" x 45"
320A	14"	24"	185	1,380	40"	4 1/2"	2 1/2"	200	43	32	8	1 1/4"	1"	51" x 53"	1,500	1,800	50" x 52" x 48"
325A	16"	18"	175	1,315	40"	4 1/2"	2 1/2"	200	45	32	8	1 1/2"	1"	52" x 57"	1,500	1,800	50" x 52" x 48"
330A	18"	24"	300	2,300	41"	4 1/2"	2 1/2"	250	60	38	8	1 1/2"	1 1/4"	58" x 59"	1,700	2,000	60" x 57" x 52"
335A	18"	30"	385	2,900	51"	4 1/2"	2 1/2"	350	80	53	8	1 1/4"	1 1/4"	58" x 59"	2,000	2,400	60" x 63" x 60"
340A	20"	20"	300	2,300	41"	4 1/2"	2 1/2"	300	65	45	8	1 1/2"	1 1/4"	58" x 59"	1,700	2,000	60" x 57" x 52"
345	24"	18"	385	2,900	33"	4 1/2"	2 1/2"	350	80	53	8	1 1/2"	1 1/4"	60" x 64"	2,100	2,500	66" x 60" x 50"
350	24"	24"	520	4,000	39"	4 1/2"	2 1/2"	400	90	60	12	2 1/2"	1 1/4"	60" x 64"	2,500	3,000	69" x 62" x 50"
355	24"	30"	650	5,000	45"	4 1/2"	2 1/2"	450	100	68	12	2 1/2"	1 1/4"	60" x 64"	2,900	3,500	69" x 62" x 53"
360	15"	44 1/2"	408	3,050	60 1/2"	4 1/2"	2 1/2"	350	88	64	12	1 1/2"	1 1/4"	58" x 59"	2,900	3,500	50" x 52" x 66"

NOTES: Weight of charge = 1/10 weight of salt. Weight of work per hour = 3/10 weight of salt. Capacity estimated with pot filled 2" from top. Salt at 1.52 specific gravity.





No. 99 Rectangular Pot Furnace

## High Temperature Rectangular Pot Furnaces

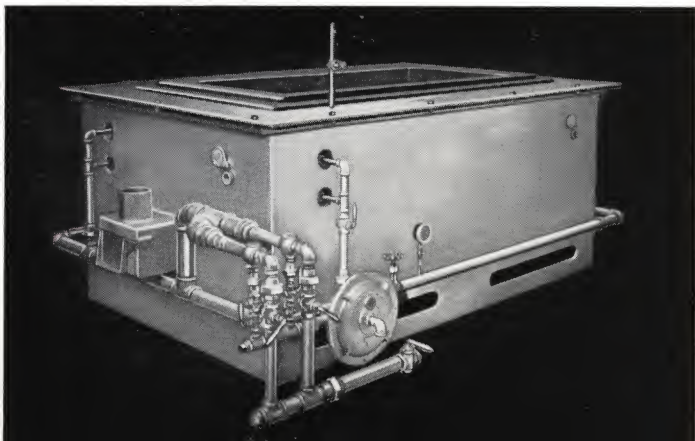
For Salt or Lead Bath Hardening Temp. Range 1000°—1600°F.

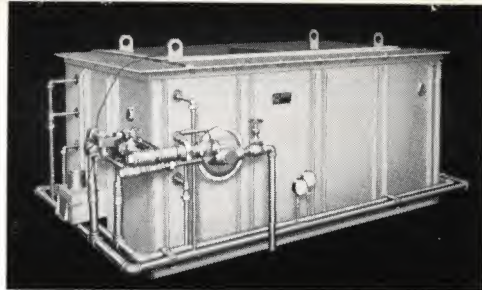
Fur. No.	Pot Size			Approx. Max. Gas Cons. (1050 B.T.U.) C.F.H.	Approx. Max. Air at 16 oz. C.F.M.	Location of Burners
	Lg.	Width	Depth			
124	18 1/4"	10 3/8"	8"	180	30	side
49A	24"	12"	11 1/2"	225	36	side
99	58"	14"	14 3/4"	250	42	bottom
102	50 1/2"	24 1/2"	15"	300	50	side
111	12"	6 1/4"	10"	85	14	side
118	19 3/4"	10 7/8"	7 5/8"	255	43	bottom

Where the cylindrical Pot Furnaces as described on preceding pages (which we consider preferable) cannot be adapted to the work, rectangular furnaces are supplied. They are side fired if deep, under fired if shallow, and usually the burners are so arranged that half of them can be turned off once operating temperature has been attained.

They are regularly supplied with cast-meehanite or chromax pots for use with lead or salt. Linings are insulating refractory backed by block insulation. The burners and combustion system are generally similar to those of the round style pot furnaces described on the preceding pages.

No. 102 Rectangular Pot Furnace





No. 106 Rectangular Pot Furnace

## Low Temperature Rectangular Pot Furnaces

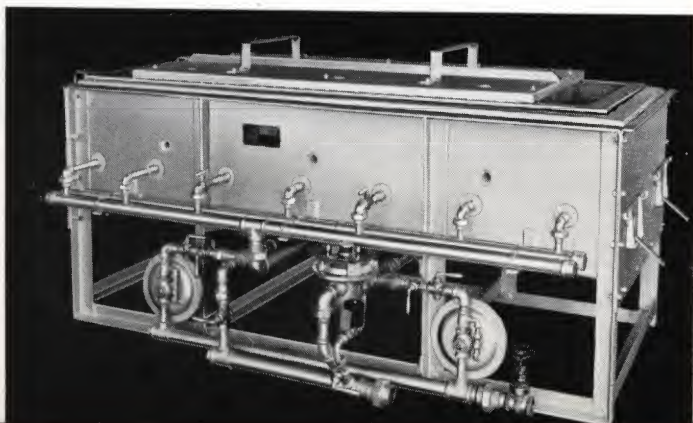
These furnaces find application especially in the heat treatment of Duralumin, annealing brass, tin dipping, lead coating, etc. also for tempering.

They are extensively used for continuous hardening and tempering of wire and strip and for lead quenching at elevated temperatures. A cover is provided to reduce radiation loss when so desired.

Temp. Range 450°—1200°F.

Fur. No.	Pot Size			Approx. Max. Gas Cons. (1050 B.T.U.) C.F.H.	Approx. Max. Air 16 oz. C.F.M.	Location of Burners	Lining
	Lg.	Width	Depth				
115	23"	15 1/4"	18"	160	27	side	4 1/2" I.R., 1" Ins.
30A	23 1/2"	15 1/4"	12"	140	25	bottom	4 1/2" I.R., 1" Ins.
114	30"	30"	30"	325	54	side	4 1/2" I.R., 1" Ins.
101	48"	18"	8 5/8"	263	44	bottom	2 1/2" I.R., 1" Ins.
107	48"	18"	40"	350	60	side	4 1/2" I.R., 1" Ins.
105	50 1/2"	24 1/2"	15"	275	56	bottom	4 1/2" I.R., 1" Ins.
112	51"	30 1/2"	30"	540	90	side	4 1/2" I.R., 1" Ins.
108	58"	21 1/2"	16 1/2"	440	74	bottom	4 1/2" F.C., 1" Ins.
104	60"	40"	11"	250	42	bottom	2 1/2" F.C., 1" Ins.
113	72"	24 1/2"	20"	600	100	side	4 1/2" I.R., 1" Ins.
100	72"	24"	7"	350	60	bottom	2 1/2" I.R., 1" Ins.
117	72"	30"	10"	500	83	bottom	4 1/2" I.R., 1" Ins.
106	72"	30"	30"	500	83	side	4 1/2" I.R., 1" Ins.
121	72"	34"	30"	650	108	side	4 1/2" F.C., 1" Ins.
119	83"	29"	28"	650	108	side	4 1/2" F.C., 1" Ins.
122	88"	34"	30"	680	114	side	4 1/2" F.C., 1" Ins.
125	96"	36"	10"	470	78	bottom	2 1/2" F.C., 1" Ins.
103	120"	40"	11"	750	125	bottom	2 1/2" F.C., 1" Ins.
109	127"	18"	14"	650	108	bottom	4 1/2" I.R., 1" Ins.

No. 100 Rectangular Pot Furnace









Bench Forges  
Convertible Bench Forges  
All Purpose Forges  
Soldering Iron Heater  
Rivet Heaters  
Regular Forges  
Cutlery Forges  
Heavy-Duty Forges  
Van-Stoning Forges



Bench Forges in a Vocational School.

ACCESSORIES &  
FLOW METERS

USEFUL DATA

FORGES

MELTERS

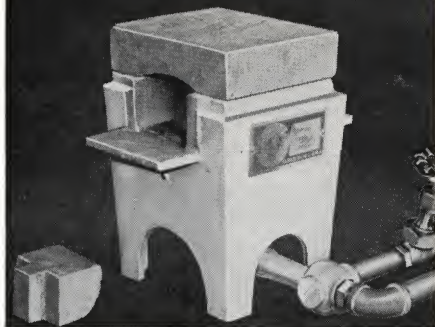
BLOWPIPES &  
BURNERS

FUR, BURNERS  
& S.V.C. SETS

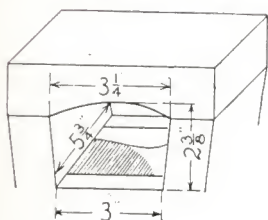
BLOWERS



No. OO Bench Forge



## Utility Bench Forge



No. OO

EVERY tool room should have one of these forges which are especially suited for quickly heating small pieces for forging, bending, tool dressing, end hardening or annealing of carbon and high speed tools, brazing, etc. A forging heat can be obtained in two minutes from

cold. Removable front, back and top bricks make them convenient for locally heating long rods for bending or otherwise forming. Opposing burner flames firing into the heating chamber assure uniform heating.

These forges are widely used for forging surgical and dental tools and in school shops, laboratories, etc.

Venturi action mixing system employing air at 1 to 1½ p.s.i. supplies air-gas mixture to burner.

Optional Feature: Compressed air reduction equipment to utilize 60 p.s.i. air as described on page 166 can be supplied at a slight additional charge.

### No. OO Bench Forge

Entrances (front and back)—3" wide x 2" high.

Heating space—4" deep.

Max. air at 16 oz.

—10 cu. ft. per min.

Max. gas consumption (1050 B.T.U.)—75 C.F.H.

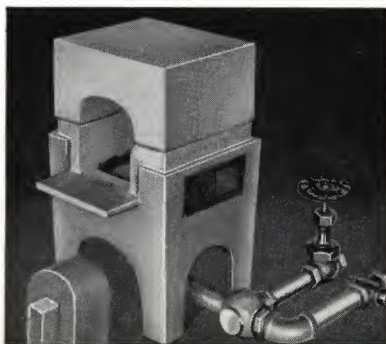
Connections—Gas, 3/8"—Air, 1/2".

Bench space—15" x 12".

Net weight—40 lbs.

Shipping weight—50 lbs.

No. OOA Bench Forge

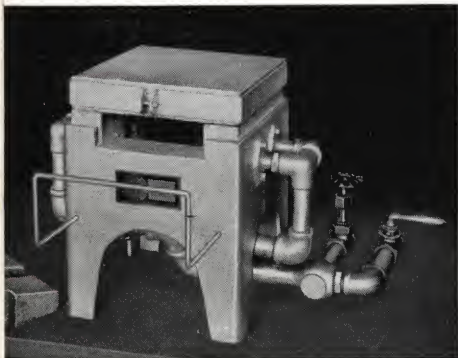


### No. OOA Bench Forge.

Entrance 3 1/2" high.

Other specifications as above for OO.





Model 89-CB Bench Forge

## **Convertible Bench Forge**

Forging, bending, tool dressing, brazing, hardening or annealing of carbon and high speed steel parts can be readily accomplished in these versatile A.G.F. Convertible Bench Forges. They are extensively used by tool rooms, school shops, manufacturers of orthopedic devices, laboratories, etc. Forging heat is obtained in 15 to 25 minutes.

Removable cover and entrance bricks increase versatility, permitting heating portions of long work or hardening unusually shaped pieces. Entrance height can be increased by placing extra bricks under the removable cover. If desired, the Model 89-DB can be supplied with an additional 89-CB top brick for increased efficiency in handling small parts.

The Model 89-DB Bench Forge can be supplied with a hole in its top brick to accommodate either a graphite crucible, cast iron pot or pressed steel pot. See figures A, B, and C. When pot or crucible is removed the furnace converts to a standard forge.

Casing is fabricated of heavy steel plate and structural members welded together.

Adjustable work supporting rack is provided at the front entrance opening.

High quality lining is of moulded hard burned fireclay. The removable cover brick is banded to give longer service life. The Model 89-DB is equipped with a Carbofrax work hearth.

Heat resisting alloy burners (two on each side) fire into the heating chamber. In the Model 89-DB, the burners fire underneath the removable hearth slab. Burner positions are staggered to insure uniform heating.

Venturi action mixing system employs air at 1 to 1½ pounds pressure to supply air-gas mixture to the burners.

### **OPTIONAL FEATURES**

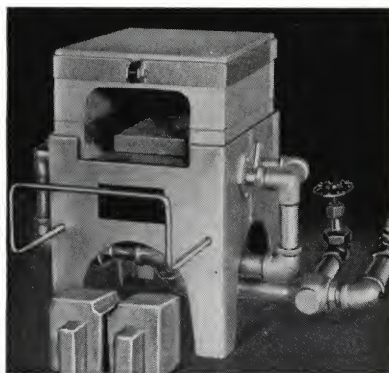
Compressed air reduction equipment to utilize 60 p.s.i. air as described on page 166 can be supplied at a slight additional charge.

Floor stand of any desired working height can be supplied for both Model 89-CB and 89-DB at a nominal cost.

Forge Model No.	Entrances		Heating Chamber		Max. Gas Consump. 1050 B.T.U. Nat. Gas Cu. Ft./Hr.	Max. Air Required Cu. Ft./Min. at 16 oz. Pressure	Supply Connections (Pipe Size)		Bench Space	Approx. Weight Lbs.	
	Width	Height	Width	Depth			Air	Gas		Net	Gross
89CB	6"	2"	6"	6"	94	13	1"	1/2"	26" x 16"	95	140
89DB	6"	4"	6"	6"	94	13	1"	1/2"	26" x 16"	100	150

†With Carbofrax hearth in position, entrance is 3 1/4" high; heating space 4 1/2" wide x 6" deep.

WHEN desired, the No. 89-DB Bench Forge may be supplied with a hole in its top brick together with a suitable top cover brick with handle to accommodate either a graphite crucible, cast iron pot or pressed steel pot as illustrated below.



Model 89-DB Bench Forge

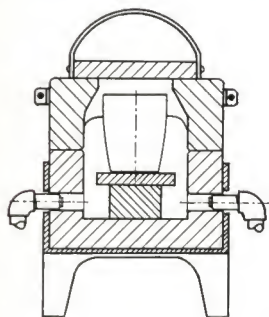


Figure A. Modified No. 89-DB Bench Forge illustrated at left is supplied with a No. 2 graphite crucible (3 3/4" outside top diameter x 4 1/2" overall height) and top cover brick with handle.

Figure B. Modified No. 89-DB Bench Forge illustrated at right is supplied with a cast iron pot pattern No. 692 with handle (pot size 3 1/2" diameter x 2 5/8" deep) and with a top cover brick with handle.

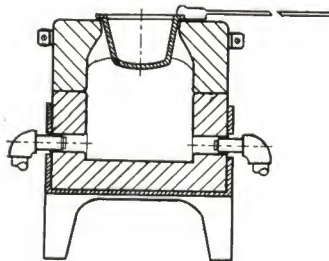
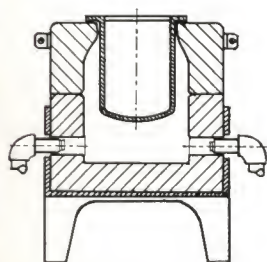
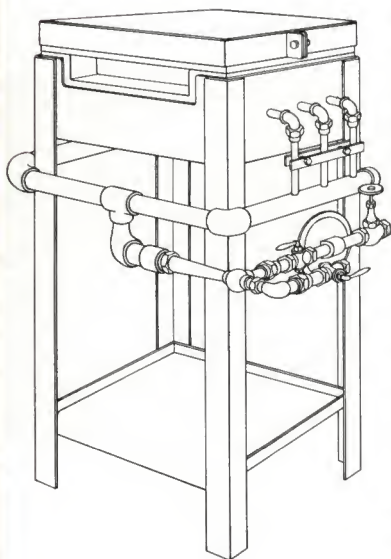


Figure C. Modified No. 89-DB Bench Forge illustrated at left is supplied with a pressed steel pot 4" diameter x 6" deep and with top cover brick with handle.





## All Purpose Forges



A.G.F. All Purpose Forges are of the same general construction as the model 89-CB. These larger model double entrance forges are especially suitable for general forging, heating ends of bars, and will easily reach operating temperatures up to 2400°F. All Purpose Forges are supplied in either regular floor models or bench models.

Casing is constructed of welded steel plate suitably reinforced with structural members.

Lining is of high grade hard burned fireclay to resist abrasion and spalling and to give longer service life.

Removable banded top cover brick adds to the range of work that may be handled. The side wall height may be built up by the use of standard firebrick to accommodate special shaped pieces.

Heat resisting alloy burners give long service life and minimize maintenance.

Single valve ratio set combustion system employs a venturi action mixer using air at 1 to 1½ pounds per square inch pressure to proportionately entrain the fuel gas for fast and efficient heating. Heat input is regulated by the operation of a single air valve. This combustion system provides a wide turn down range necessary to achieve rapid heating as well as the ability to hold at temperature.

### OPTIONAL FEATURES

Atmosphere adjusting burners. To reduce scaling to a minimum, these forges can be equipped with special atmosphere adjusting burners to surround the work with a highly reducing atmosphere.

Compressed air reduction equipment to utilize 60 p.s.i. air as per page 166 can be supplied.





## All Purpose Forges

Forge Model No.	Entrances		Inside Depth	Max. Gas Consump. 1050 B.T.U. Nat. Gas Cu. Ft./Hr.	Max. Air Required Cu. Ft./Min. at 16 oz. Pressure	Supply Conn. Pipe Size		Bench or Floor Space	Approx. Weight Lbs.	
	Width	Height				Air	Gas		Net	Gross
*139	12"	2"	12"	200	27	1 1/4"	3/4"	24"	400	500
139A	12"	2"	12"	200	27	1 1/4"	3/4"	x	450	600
‡139AA	12"	4 1/2"	12"	200	27	1 1/4"	3/4"	35"	450	600
*142	12"	8"	12"	200	27	1 1/4"	3/4"	24" x	400	550
142A	12"	8"	12"	200	27	1 1/4"	3/4"	35"	450	600

\*Bench Type

‡Single Entrance

## Soldering Iron Heater

The Model No. 2 Soldering Iron Heater is recommended for the fastest and most efficient heating of soldering irons. The heater has a capacity of two four pound irons and is equipped with a rack for holding the irons horizontally in the heater.

### CONSTRUCTION FEATURES:

Casing is fabricated of cast iron and sheet steel suitably reinforced.

Lining is fabricated of high quality hard burned fireclay.

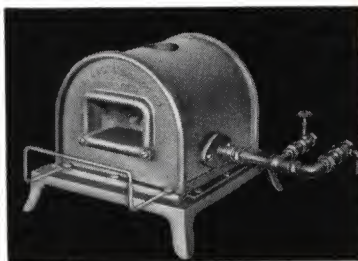
Venturi action mixing system employs air at 1 to 1 1/2 p.s.i. to supply air-gas mixture to the burners.

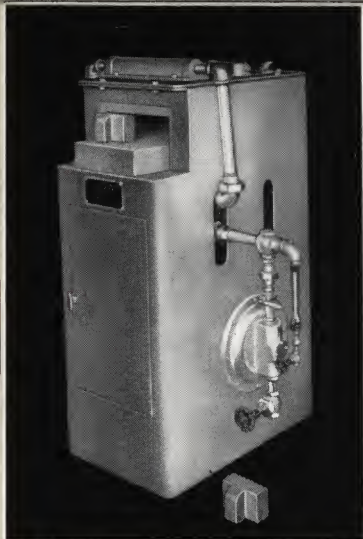
### OPTIONAL FEATURE:

Compressed air reduction equipment to utilize 60 p.s.i. air as described on page 166 can be supplied at a slight additional charge.

#### Model No. 2

Entrance.....3 1/4" wide x 1 3/4" high  
 Depth.....4 1/2"  
 Max. air at 16 oz.....7 Cu. Ft./Min.  
 Max. gas  
 (1000 b.t.u.).....50 Cu. Ft./Hr.  
 Connections.....Gas 1/4"—Air 3/8"  
 Bench space.....12" x 16"  
 Net weight.....36 lbs.  
 Shipping weight.....50 lbs. approx.





No. 2A Rivet Heater.

Note use of high pressure air mixer as per page 166.

## Rivet Heaters

IN our Rivet Heaters or Rivet Forges the flame is directed downward directly upon the work, thus securing rapid, efficient, and economical heating.

As may be seen from the illustration of the No. 2A, the casings are of modern all welded steel construction with a handy storage space underneath for tongs, tools, etc.

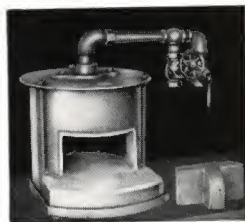
The No. 1 is a bench style with one opening, as shown, but the others are charged at the top in the rear of the furnace and hot rivets are removed at the front. The No. 2A and 3A are similar in appearance.

The No. 5A is provided with two vertically sliding doors so that work may be drawn from either side independently.

These furnaces, excepting the No. 1, are regularly supplied with our Single Valve Ratio Set which automatically maintains the desired air-gas ratio. Heat input is controlled by the air cock only.

The floor bricks are made from hard burned refractory for maximum abrasion resistance.

Capacities. The Model 1 Bench Style Rivet Heater is suitable for handling rivets up to sizes ranging from  $\frac{3}{8}$ " to  $\frac{1}{2}$ " diameter. The Model 2A Rivet Heater will handle a 30 pound charge of rivets up to  $\frac{3}{4}$ " diameter, 3" long. Heating rate of  $\frac{3}{4}$ " rivets is from 180 to 200 per hour.



No. 1 Rivet Heater

The Model 3A will accept a charge of 50 pounds and will easily heat 100 pounds of rivets per hour. Rivets up to 4" in length may be easily handled in this model. The largest Model 5A heater will handle 200 pounds of rivets per hour.

Rivet Heater No.	Inlet at Top		Discharge		Length of Chamber	Max. Gas Consumption, C.F.H. 1050 B.T.U. Gas	Max. Air Req. C.F.M. at 16 oz.
	Width	Length	Width	Height			
1	—	—	5 $\frac{3}{4}$ "	3 $\frac{1}{2}$ "	6 $\frac{1}{4}$ " (I.D.)	94	13
2A	4"	9"	9"	3"	17"	112	15
3A	5"	11"	12"	4"	25 $\frac{1}{2}$ "	200	27
5A	7"	17"	18"	7 $\frac{3}{4}$ "	48"	500	70



## Regular Forges

FOR the heating of all kinds of small and medium size work, including chisels, lathe and planer tools and for forging generally, our Regular Forges are extensively used. The opening at the rear is identical with the front opening to permit heating work at a mid-point for up-setting or bending.

These forges are provided with our single valve ratio set, thus giving quick adjustment by means of one valve only and the correct air to gas mixture for most efficient heating over the entire operating range.

Large specially moulded hard burned refractory sections are used in the lining to insure a long life with a minimum of repairs. Heat resisting alloy burners fire in from both sides of the heating chamber.

A special feature of these furnaces is their short heating up time and the speed with which work can be turned out.

The usual dirt, smoke and other disadvantages of coal or oil forges is entirely eliminated. Furthermore these gas forges are provided with our Single Valve Ratio Set, which gives quick adjustment of heat input by means of the air cock only, maintaining the selected "air to gas" ratio automatically. Thus a rich fire can be used to reduce scaling to a minimum.

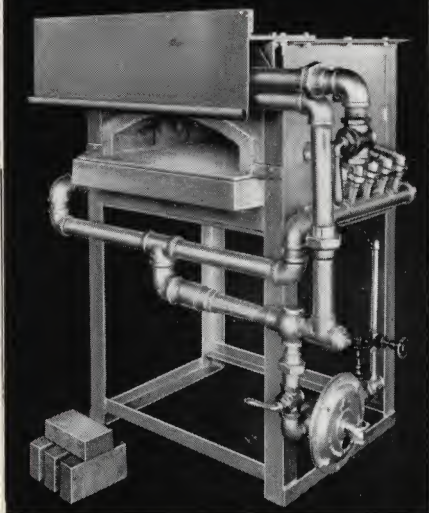


No. 2B Forge

Forge No.	Entrances		Inside Depth	Maximum Gas Consumption, 1050 B.T.U. cu. ft. per hr.	Maximum Air Required in cu. ft. per min. at 16 oz.	Floor Space
	Width	Height				
2B	5½"	3"	6"	175	24	24" x 24"
3E	9"	2"	12"	250	34	30" x 26"
*5H	11"	3"	12"	300	40	32" x 26"
5HB	11"	5"	14"	250	34	32" x 26"

\*Single or double entrance.





## Heavy Duty Forges

Used in many plants for production forging of medium and heavy parts, our Heavy Duty Forges entirely eliminate the dirt and smoke characteristic of oil or coal fired equipment.

They are constructed throughout for hard service with an extra heavy welded steel plate casing and a lining of  $4\frac{1}{2}$ " of highest quality hard burned fire

clay refractory backed by block insulation. The hearth is of Sillimanite to resist abrasive action and any slagging action which may occur. The comparatively high absorption characteristics of this refractory hearth mean that the heat stored in it is given up to the under side of the work when it is placed in position. The hearth extends out from the chamber slightly to make a convenient working shelf.

Numerous small heat resisting alloy burners firing across the forge under the arch insure rapid, efficient heating. The single valve ratio set which serves them provides the correct mixture of air and gas at all times for efficiency and for the most desirable atmospheric conditions to hold scaling at a minimum.

Atmosphere adjusting burners, which enter between the regular heating burners, make it possible to carry a highly reducing atmosphere where it is desired to reduce scaling further.

Preheating pipe for the air extending in a "U" across the front of the furnace and a shield to protect the operator are also provided. An auxiliary rear entrance may also be furnished if it is desired to heat parts of long work.

Forge No.	Entrance			Heating Space Length	Max. Gas Cons. CFH 1050 B. T. U. Gas	Max. Air Req. CF.M. at 16 oz.	Supply Conn. Pipe Size	
	Width	Center Height	Side Height				Air	Gas
143	18"	$6\frac{1}{2}$ "	4"	12"	310	41	$1\frac{1}{2}$ "	1"
†148	20"	$12\frac{1}{2}$ "	9"	38"	740	98	$2\frac{1}{2}$ "	2"
145B	24"	—	$1\frac{1}{2}$ "	9"	290	40	$1\frac{1}{2}$ "	1"
145	24"	—	$3\frac{1}{2}$ "	9"	290	40	$1\frac{1}{2}$ "	1"
129A	24"	$6\frac{1}{2}$ "	3"	19"	450	60	$2\frac{1}{2}$ "	$1\frac{1}{4}$ "
144	24"	$6\frac{1}{4}$ "	3"	38"	650	90	$2\frac{1}{2}$ "	$1\frac{1}{2}$ "
†149	24"	—	6"	48"	765	102	$2\frac{1}{2}$ "	2"
†150	24"	13"	10"	24"	485	72	2"	$1\frac{1}{2}$ "
146	36"	—	3"	24"	650	90	$2\frac{1}{2}$ "	$1\frac{1}{2}$ "

†With sliding door.



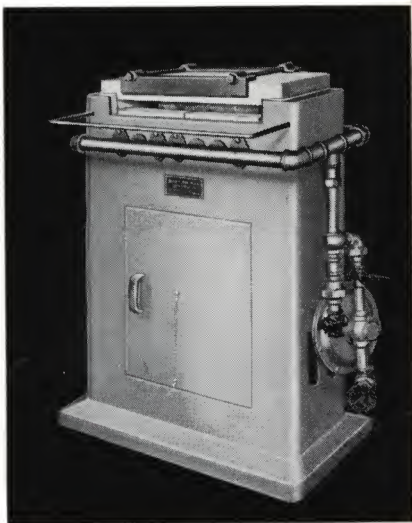
## Cutlery Forges

**C**UTLERY Forges find application especially on production jobs where heating the ends of numerous small blanks is involved, such as scissor blanks, small chisels, punches, etc. A number of pieces are heated simultaneously and as rapidly as a hot piece is removed it is replaced with a cold one.

The cover brick is removable so that increased height can be obtained where required and to facilitate repairs.

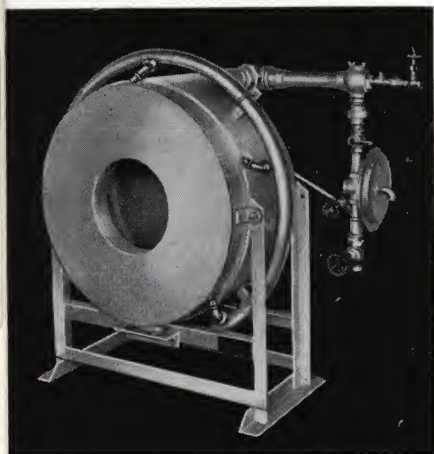
The back is closed by means of a brick which can be slid forward or backward as desired for adjusting the depth of the heating chamber. This brick may also be removed entirely, thus converting the forge to double-entrance style.

Air gas mixture is supplied for these Forges by our Single Valve Ratio Sets, which give quick adjustment of heat input by means of the air cock only, maintaining the desired air to gas ratio automatically, thus a rich fire can be used to reduce scaling to a minimum.



No. 78H Forge

Forge No.	Entrances		Inside Depth	Max. Gas Consumption cu. ft. per hour 1050 B.T.U.	Maximum Air Required in cu. ft. per min. at 16 oz.	Supply Conn. Pipe Size		Floor Space
	Width	Height				Air	Gas	
20D	15"	1 1/2"	4"	175	25	1 1/4"	3/4"	29" x 20"
78H	20"	2 1/2"	6"	250	34	1 1/4"	1"	40" x 21"
78HA	20"	1"	6"	200	27	1 1/4"	1"	40" x 24"
130B	20"	2"	12"	225	30	1 1/4"	1"	40" x 28"
130C	20"	6"	12"	250	34	1 1/4"	1"	40" x 28"



## Van Stoning Forges

No. 138 Van Stoning  
Forge with single valve  
ratio set.

**T**HESE forges were originally designed for heating the ends of heavy pipes and tubes, for rolling out a flange, in making the Van Stone type of joint.

These Forges are also used for the heating of various styles of tubing, for flanging, as mentioned above, or for necking.

Burners fire tangentially for uniform, rapid heating of the end of the work without flame impingement.

The front brick is readily removable to permit one with a larger or smaller hole being substituted, according to the size of the pipe or tubing being heated.

Lining is of heavy hard burned specially moulded refractory. The burners are of heat resisting alloy and are served by our Single Valve Ratio Set.

No.	I. D. of Chamber	Length Inside End Bricks	Maximum Opening Front Brick	Max. Gas Consumption C.F.H. 1050 B.T.U. Gas	Air Req. C.F.M. at 16 oz.
*136	10"	8"	6" dia.	120	20
137	18"	7"	12" dia.	250	35
138	28"	10"	20" dia.	550	75

\*Bench Type.





Bench Type Melters

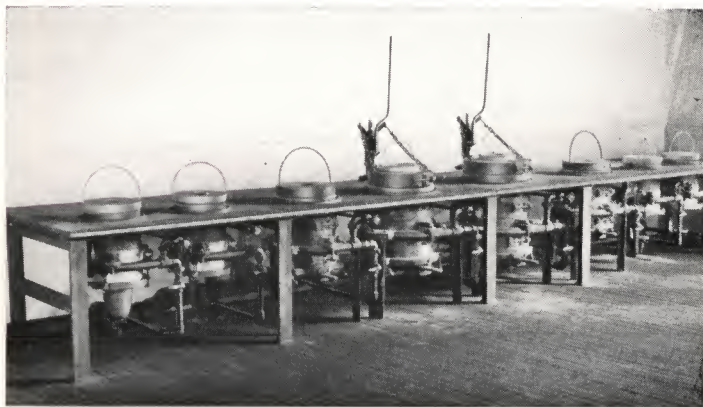
Regular Melters

Brass Melters

High Heat Melters

Aluminum Melters

Soft Metal Melters



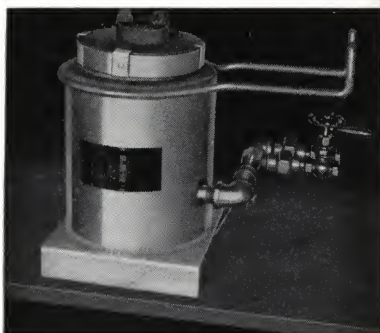
A Battery of Regular Melters for the  
U. S. Mint in San Francisco.





# Gold and Silver Melter

Improved No. 1-B  
High Heat Melter



THESE small melters are used principally for small melts of gold and silver and for experimental and test work in laboratories.

The No. 1-A Little Giant Melter is designed for the melting of precious metals. The furnace can be easily disassembled by the removal of three wing nuts, thus facilitating recovery of precious metal in the event of crucible breakage.

The No. 1-B High Heat Melter is especially designed for laboratory work and other melting operations which require temperatures up to 1800°F.

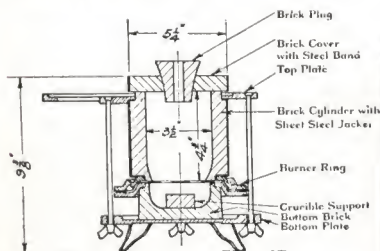
The time required to melt 10 ounces of copper, using air at one pound per square inch, is 10 minutes.

Improved Venturi Mixer simplifies adjustment and increases heating efficiency.

Furnace lining is of fire clay refractory and insulation for economy and increased speed.

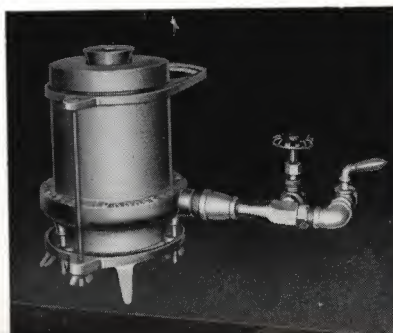
A convenient rack is provided for supporting the hot cover, when removing the crucible.

Melter No.	1-A	1-B
Capacity—No. 0000 black lead crucible, which will hold one and a half pounds, troy weight, of gold when $\frac{3}{4}$ full.		
Max. air at 16 oz. C.F.M.	5	6
Max. gas (1050 B.T.U.) in cu. ft./hr.	30	40
Connections { Gas	$\frac{1}{4}$ "	$\frac{1}{4}$ "
{ Air	$\frac{3}{8}$ "	$\frac{3}{8}$ "
Bench Space	12" x 17"	10" x 14"
Net Weight, lbs.	15	27
Shipping Weight, lbs.	25	40

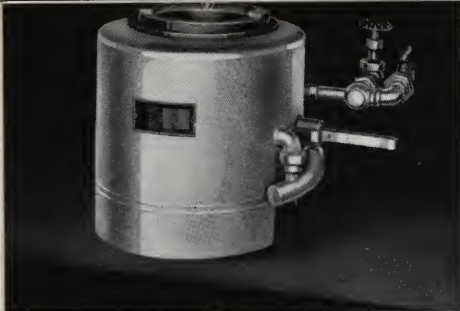


Cross Section of No. 1-A

No. 1A "LITTLE GIANT" MELTER.







## No. 12-C Melter

No. 12-C Melter equipped with cast iron pot.

A versatile, compact gas-fired bench furnace which can be used either as a crucible or pot type melter.

As a melter, the No. 12-C easily achieves operating temperatures of 2250°F. for the crucible melting of brass, silver, gold, etc.

The same furnace will readily accommodate either a cast iron or pressed steel pot for melting lead and other soft metals.

The No. 12-C Melter is of rugged and durable construction which includes the use of two alloy burners, venturi action mixer, high quality hard burned fireclay lining, heavy sheet steel furnace body and pot supporting ring.

### SPECIFICATIONS

For the melting of various soft metals, the furnace is equipped with a cast iron pot having a pouring spout and lifting lugs to permit the use of a lifting bar when pouring. The pot is 6" in diameter x 5" deep and has a capacity of approximately 40 pounds of lead.

For crucible melting, a suitable refractory cover, with handle, crucible supports and #4 graphite crucible can be supplied. Capacity of No. 4 graphite crucible is as follows:

Bronze and Brass—approximately 10 pounds.

Gold—approximately 29 pounds troy.

Silver—approximately 16 pounds troy.

Aluminum—approximately 3 pounds.

For special requirements a cast iron crucible 4½" in diameter x 5" deep can be supplied.

Chamber Size: 8" diameter x 7½" available depth.

Maximum Air Requirement: Approximately 7 cu. ft./min. at one pound per square inch pressure.

Maximum Gas Consumption:

40 c.f.h. 1050 b.t.u. natural gas.

Connections: Air—¾", Gas—⅜".

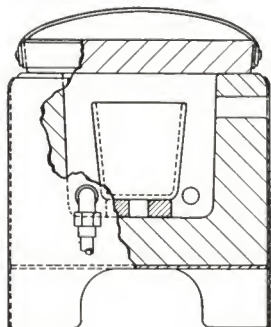
Bench Space: 20" x 24".

Net Weight—approximately 120 pounds.

Shipping Weight—approximately 150 pounds.

Shipping Measure for Export—24" x 24" x 22".

No. 12-C Melter equipped with crucible supports, crucible and banded top cover with handle.



## Regular Melters

A.G.F. Regular Melters are principally used by jewelry manufacturers for melting gold and silver; however, they are also ideally suited for making small melts of copper, brass, aluminum, etc.

The Model No. 2 has a maximum recommended operating temperature of approximately

2200°F. The standard Model No. 3 and No. 4 Regular Melters achieve operating temperatures of approximately 2700°F. The Model No. 3 can be equipped with a high temperature refractory lining for temperatures up to approximately 2900°F.

The No. 2 Regular Melter is mounted into a working table 22" wide x 29" long. Models No. 3 and 4 have tables with a working space approximately 20" x 20".

### CONSTRUCTION FEATURES INCLUDE:

High quality hard burned fireclay lining consists of four easily removable sections—cover, upper cylinder, lower cylinder and crucible support.

Circular manifold has three burner tips equally spaced apart and firing tangentially into the heating chamber to assure uniform heating of the crucible. Single valve ratio set permits one valve regulation of heat input and provides superior control of combustion.

A drip crucible is provided underneath the melter together with a suitable draw-out hole in the bottom of the heating chamber to contain molten metals in event of crucible breakage or spillage.

See tabulation of sizes on following page.



No. 3 Regular Melter



No. 2 Regular Melter



## Regular Melter Models

Regular Melter No.	Black Lead Crucible Number	Capacity in lbs. (Troy) of Gold $\frac{3}{4}$ Full	Gas 1050 B.T.U. Maximum Cubic Ft. Per Hour	Air cu. ft. per min. at 16 oz. Pressure	Size of Chamber	
					Dia	Depth
2	4	17	63	10	6"	7 $\frac{1}{2}$ "
3	8	37	150	25	7"	9 $\frac{5}{8}$ "
4	10	55	175	29	8 $\frac{1}{2}$ "	10 $\frac{5}{8}$ "



No. 3 Regular Melter arranged for Determination of the Fusibility of Coal Ash.

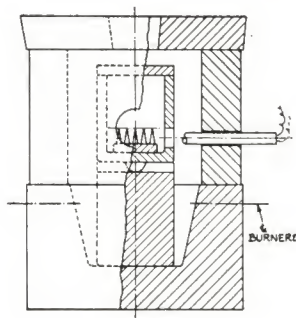
With observation Tube, Thermocouple Hole and a Set of Older Style Crucibles (For latest style crucibles, see diagram below)

The No. 3 Regular Melter with high temperature lining as previously described, but without drip crucible is also supplied as illustrated for determining the fusibility of coal ash—see A.S.T.M. De-

signation D271-42, also Bureau of Mines Bulletin No. 129. Temperatures up to 3000°F. can be obtained. It can when so desired, be supplied with a Sillimanite lining for longer life at maximum temperatures.

The upper cylinder has two holes, an observation hole 2" in diameter with its center 4" from the top of the cylinder and a 1" thermocouple hole 90° to the right, bottoms of the two holes being in the same horizontal plane. The observation hole is equipped with a Sillimanite tube, brass sleeve and glass window. Corundite crucibles are supplied as shown in the picture, or in accordance with the cross sectional diagram shown below, the latter being a slightly simpler and preferable setup.

Accessories can be obtained from the Scientific Supply houses.







## Large Regular Melters

OUR Regular Melters are used principally for melting gold and silver in black lead crucibles. Three burners fire tangentially to prevent flame impingement on the crucible. All parts are readily detachable and easily replaced. The crucible support assembly is held in place by a support bar which can be quickly knocked out to drop the entire bottom and contents in event of crucible breakage. The Nos. 4½, 5, 7 and 9 Regular Melters have a swing lifting device for raising and moving to one side the heavy top refractory brick for access to the crucible.



No. 4½ Regular Melter  
arranged with table.

These Melters are regularly designed for temperatures up to 2500°F.

All of these Melters are supplied with our single valve ratio set, thus providing proper combustion throughout the entire operating range.

### Refining Melter

The No. 4½ Regular Melter is known as a No. 4½ Refining Melter when it is supplied with a drip crucible. Longer legs, and a bottom arrangement similar to that used in the No. 3 are used in this case.

Regular Melter No.	Black Lead Crucible Number	Capacity in lbs. (Troy) of Gold ¾ Full	Gas 1050 B.T.U. Maximum Cubic Ft. Per Hour	Air cu. ft. per min. at 16 oz. Pressure	Size of Chamber	
					Dia.	Depth
4½	16	78	175	29	9"	11"
5	20	112	250	41	10½"	11½"
7	40	212	460	*77	12½"	14¾"
9	100	462	643	*107	15½"	17¾"

\*Air blast at 24 oz.



## High Heat Melter

No. 410 High Heat Melter  
with Single Valve Ratio  
Set.

The No. 410 High Heat Melter is designed for high temperature operation and is ideally suited for experimental melting of such materials as copper, brass, nickel, steel, glass, etc. This gas-fired melter can readily achieve temperatures of 2800°F. operating with gas and air at 1½

pounds per square inch pressure. Temperatures in excess of 3000°F. can be achieved by equipping the melter with a special oxygen injection feature.

High efficiency lining consists of an inner cylinder of super heavy-duty refractory backed with an outer cylinder of high grade insulating refractory to give long life under severe operating conditions.

Swing lift type mechanism is provided for the cover to easily raise it and swing it to either side.

Four alloy burners, equally spaced apart, fire tangentially into the heating chamber through super refractory burner tunnels, thus assuring uniform and efficient heating, with quiet operation.

A drip crucible is provided underneath the melter with a suitable drain-out hole in the chamber.

High Heat Melter No.	Size of Chamber		Graphite Crucible Number	Height to Top of Furnace Chamber	Lining		Max Gas(1050B.T.U.) Cu. Ft. Per Hr.	Max. Air Cu. Ft./Min. at 24 oz. Pressure
	Diameter	Depth			Super Refractory	Insulating Refractory		
410	9½"	12"	10	32"	1"	2½"	275	46

## Brass Melters

No. 3 Brass Melter with  
Single Valve Ratio Set.



A.G.F. Brass Melters are suitable for melting all types of non-ferrous metals including bronze, copper, copper alloys, silver, gold, aluminum, etc. at operating temperatures up to approximately 2300°F.

The lining is of high quality, hard burned refractory. Lining consists of five easily removable components—vent cover, top cover, chamber, cylinder, crucible supports and bottom brick.

Burners fire tangentially to prevent flame impingement on the crucible. They are located well above the bottom so that in case of crucible breakage they are not clogged. A bottom outlet which also serves as a lighting hole is also provided for drainage in case of crucible failure.

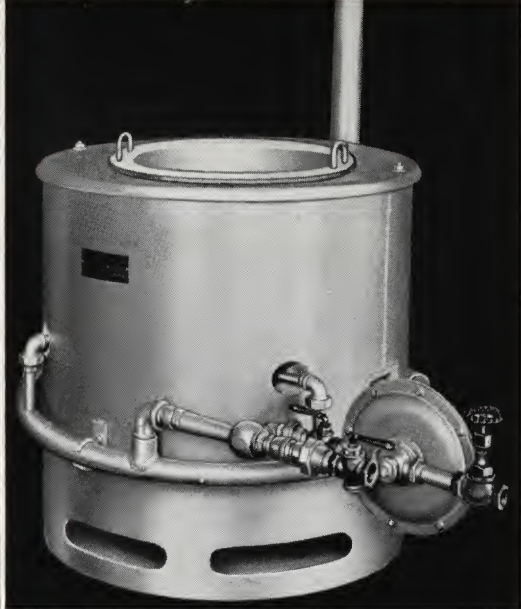
The main cover, which is easily removed with the cover lifting mechanism, has a large hole for charging as melting progresses. It is closed by a small cover with a vent hole.

With these melters, the first heat is obtained in one hour and 30 minutes, the second in one hour and 20 minutes, and the third and subsequent heats in one hour or less. Gas consumption for the first heat, provided the melter is in good condition, is at the rate of 6 cubic feet per pound; for the second heat, 5 cubic feet per pound, and for the third and subsequent heats, 4 cubic feet per pound.

Brass Melter No.	Black Lead Crucible Number	Capacity in lbs. of Brass $\frac{3}{4}$ Full	Gas 1050 B.T.U. Maximum Cubic Ft. per Hour	Air cu. ft. per min. at 16 oz. Pressure	Size of Chamber	
					Dia	Depth
1	25	70	225	37	12 $\frac{1}{2}$ "	12 $\frac{1}{2}$ "
2	40	120	250	41	13 $\frac{3}{4}$ "	14 $\frac{1}{2}$ "
3	50	150	375	62	14 $\frac{1}{2}$ "	15 $\frac{3}{4}$ "
4	60	180	502	*83	15"	18"
5	80	240	550	*92	16 $\frac{1}{2}$ "	19"
6	200	500	800	*133	21 $\frac{1}{2}$ "	23"

\*Air blast at 24 oz.





No. 375  
Aluminum  
Melter with  
Single Valve  
Ratio Set.

## Aluminum Melters

(Pot Type)

Aluminum Melters are designed for rapid and efficient melting of non-ferrous metals at temperatures up to 1400°F.

All models are supplied with standard cast iron pots for ladling out operation. Model No. 375-AD has a bottom draw-off pot with an external shut-off cock.

High efficiency lining comprises 4½" insulating refractory backed with 2" of block insulation. This type of lining construction insures fast heating and economical operation.

Heavy sheet steel furnace body is ruggedly constructed for long life.

Heavy wall cast iron pot gives long operating life.

Tangential firing. Multiple burners of alloy—four on Model No. 375 and eight on Model No. 372 fire tangentially into the heating chamber, thus assuring uniform heating. Single valve ratio set provides one valve control of heat input and combustion.

Aluminum Melter No.	Approx. Size of Pot		Capacity of Pot Lbs. of Aluminum	Height to Top of Pot	Lining		Max Gas(1050B T.U.) Cu. Ft. Per Hr.	Max. Air Cu Ft./Min. at 16-oz. Pressure
	Diameter	Depth			Insulating Refractory	Insulation		
†375A	17"	17½"	300*	32"	4½"	2"	200	33
372A	24"	18½"	500*	36½"	4½"	2"	450	75

\*Filled to within 2" of the top.

†When supplied with bottom draw-off Pot known as No. 375-AD.

# Soft Metal Melters

A.G.F. Soft Metal Melters are ideally suited for the melting of tin, lead, babbitt, etc. at temperatures up to 1000°F. All models are gas fired; however, the No. 372 can be furnished for oil firing.

All standard models listed below are supplied with regular cast iron pots for ladling out operation. Models 371-A and 372-B are equipped with bottom draw-off pots with internal shut-off valves.



No. 371 Soft Metal Melter

## CONSTRUCTION FEATURES INCLUDE:

High quality insulating refractory lining permits fast heating and economical operation.

Heavy wall cast iron pot is supplied to give long operating life.

Models No. 370 and 371 are equipped with a bottom burner which produces a tangential flame to uniformly heat the pot. The No. 372 is equipped with four alloy burners equally spaced apart, firing tangentially into the chamber to produce uniform heating of the pot and contents.

Single valve ratio set provides one valve control of heat input and combustion.

Soft Metal Melter No.	Pot Type		Size of Pot		Capacity of Pot, Lbs. of Lead	Height to Top of Pot	Lining (Insulating Refractory)	Maximum Gas Consumption - 1050 B.T.U. Natural Gas Cu. Ft./Hr.	Max. Air Required Cu. Ft./Min. at 16 oz. Pressure	Supply Connections	
	Standard	Bottom Draw-off	Diameter	Depth						Air	Gas
120	✓		10 1/4"	8 3/4"	160	34 1/4"	2 1/2"	85	13	1"	1/2"
370	✓		11 1/2"	10 1/2"	335	34 1/2"	2 1/2"	88	14	1"	1/2"
371	✓		17"	12 1/2"	835	34"	2 1/2"	112	18	1 1/4"	3/4"
371-A		✓	18 3/4"	14 1/4"	1000	37 1/2"	2 1/2"	125	21	1 1/4"	3/4"
372	✓		24 1/4"	18"	2400	30"	4 1/2"	175	29	1 1/2"	1"
372-B		✓	26 3/4"	16 1/4"	2700	30"	4 1/2"	200	33	1 1/2"	1 1/4"







“Super” Blowpipes

“On & Off” Blowpipes

Large Blowpipes

Open Flame Burners

Machlet Tips

Ribbon Burners

Fish Tail Burners

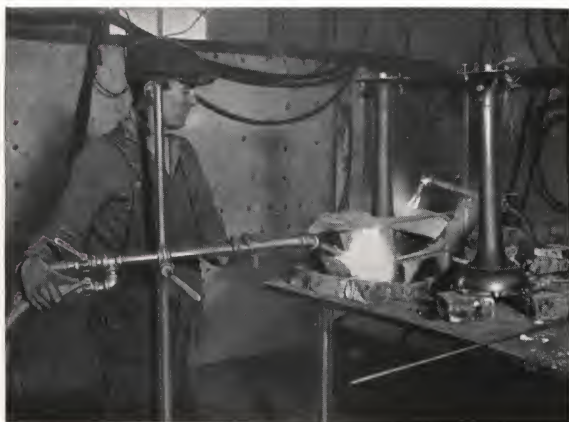
Hand Fires

Glass Fires

Cross Fires

Oxygen Gas Burners

Soft Metal Burners



Using a Large Blowpipe for Brazing.





## "Super" Blowpipes

THESE blowpipes are supplied for manufactured gas, natural gas, mixed natural and manufactured gas, also the gases marketed in cylinders, such as propane and butane. Best results are obtained with air at 1 to 2 lbs./sq. in. and gas at 3" to 6" water column pressure. Air at high pressures may also be utilized by means of one of the high pressure air reducers shown on page 148.

Anything between a soft, mild flame and an extremely sharp concentrated fire is obtainable. They are adapted for: (1) Laboratory work; (2) Soldering and brazing; (3) Automobile radiator repair work; (4) Automobile body work; (5) General work in the electrical field; and (6) Local annealing and hardening.

Hand Blowpipe→

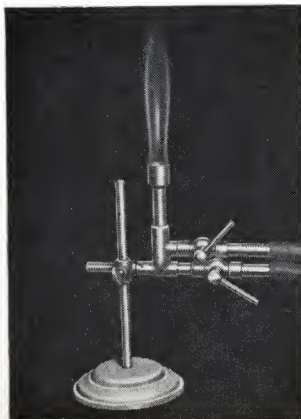


Blowpipe No. For Manufactured Gas	Blowpipe No. For Natural Gas, Mixed Natural and Mfd Gas, or for Bottled Gas	Maximum Size of Flame, Inches		Max. Gas Consumption B. T. U. Per Hour with air at 3 p.s.i.	Max. Air cu. ft./Min. at 3 p.s.i.	Supply Connections Outside Diameter Inches		Overall Length Hand Blowpipe, Inches
		Diameter	Length			Gas	Air	
000	000N	$\frac{3}{16}$	4	2,625	.5	$\frac{5}{16}$	$\frac{5}{16}$	11 $\frac{1}{4}$
00	00N	$\frac{3}{8}$	4	5,250	1.0	$\frac{5}{16}$	$\frac{5}{16}$	11 $\frac{1}{4}$
0	0N	$\frac{1}{2}$	4	10,500	1.6	$\frac{5}{16}$	$\frac{5}{16}$	11 $\frac{1}{4}$
1E	1EN	$\frac{3}{4}$	6	18,900	3.0	$\frac{5}{16}$	$\frac{5}{16}$	11 $\frac{1}{4}$
1	1N	$\frac{3}{4}$	6	18,900	3.0	$\frac{3}{8}$	$\frac{3}{8}$	14
2	2N	$1\frac{1}{4}$	9 $\frac{1}{2}$	52,500	9.0	$\frac{9}{16}$	$\frac{9}{16}$	16
3	3N	$2\frac{1}{2}$	15	115,500	19.0	$1\frac{1}{16}$	$1\frac{1}{16}$	19

Each "Super" Blowpipe contains a built-in venturi mixer, which produces thorough mixing of the gas and air prior to combustion. They should not be confused with inferior "nozzle-mixing" blowpipes, in which the gas and air are fed through concentric tubes and mixed at the nozzle, giving a ragged flame which has a narrow range of adjustment and cannot be brought into sharp focus.

These blowpipes are supplied in two types—hand and stand as illustrated which produce exactly the same flame characteristics. The Tips used are not interchangeable from one type to the other. However, in each of the types, the 000, 00, 0 and 1E tips of both the "N" and manufactured gas types, all fit into what is known as a No. 0 frame. All other sizes are not interchangeable.

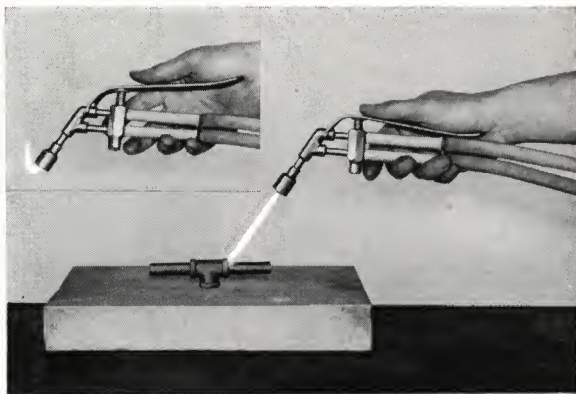
Stand Blowpipe→







## "On and Off" Blowpipe



**I**N many soldering and brazing operations, the operator desires a specific type of flame at intervals only. On and Off Blowpipes provide this instantaneous control with a spring-type valve for opening the gas and air simultaneously. When it is released, a small pilot flame continues to burn.

These Blowpipes are made in two size frames with levers, the No. 0 and No. 2. The No. 0 frame accommodates tips Nos. 000, 00, 0 and 1-E of both the "N" and manufactured gas types as listed on Page 127. The No. 0 frame is  $7\frac{3}{4}$ " overall and has the gas and air tubes encased in suitable insulation. Hose  $\frac{1}{4}$ " I.D. should be used.

The No. 2 frame is  $12\frac{1}{2}$ " overall and it takes only the No. 2 and 2N heads with characteristics as listed on Page 127. Hose  $\frac{1}{2}$ " I.D. should be used.

**Note** No valves for adjusting air and gas are included in this type of Blowpipe. It is therefore necessary for the user to provide valves or cocks at the other end of the hose line. The "On and Off" valve only turns air and gas completely on or off as its name implies, excepting the small gas pilot which may be adjusted by a screw under the body of the "On and Off" valve.

The "Super" Blowpipes on page 127 are equipped with cocks for adjustment of air and gas, but have not the "on and off" feature. When ordering this type specify "ON AND OFF" BLOWPIPE WITH LEVER.



## Large Blowpipes

Our large Blowpipes are designed especially for:

1. Brazing.
2. Preheating for welding.
3. Heating temporary furnaces built up of brick.
4. In shipyards for coppersmithing, heating pipe for flanging and bending, etc.
5. Miscellaneous applications such as crucible pre-heating, mold drying, hog singeing, and in general for any open flame application.

Blow-pipe No.	Approximate Size of Flame in Inches		Max. Gas Cons. B.T.U. Per Hr. Based on 525 B.T.U. Mfd. Gas	Max. Air cu. ft. / Min. at 16 oz.	Supply Connections in Inches		Length of Blow-pipe in Inches
	Dia.	Length			Air	Gas	
*24	7/8	9	18,375	3	3/8	3/8	14
*35H	1 1/4	13	65,625	9	9/16	9/16	16
†36	2	15	120,750	17	7/8	7/8	24
†37	3	20	241,500	36	1 5/16	1 5/16	37
†37S	3	26	393,750	50	1 5/16	1 5/16	37
§37-T	3	26	393,750	50	1 5/8	1 5/8	36
†432-A	4	36	787,500	100	1 7/8	1 7/8	36
§432-G	4	36	787,500	100	1 7/8	1 7/8	36

\*Brass frame with adapter.

†Regular pipe frame and iron head.

§Drawn Steel Venturi Tube and alloy head.

They are of heavy construction to withstand rough usage.

Mixing of the gas and air takes place well in back of the head so that there is ample opportunity for them to thoroughly mix before combustion takes place, thus insuring maximum efficiency.

These Blowpipes are furnished either with or without a stand and clamp as illustrated. In the larger sizes, Nos. 37T and 432G are preferred for use as hand type because of their lighter weight.

When used to heat temporary furnaces or when firing into a brick tunnel the head should be back at least 1/2" from the opening.

Air at one to 2 pounds per square inch pressure is required for their operation. Where such air is not available, high pressure air may be utilized by means of equipment as per page 148.

A variety of different styles of brazing tables employing these large Blowpipes can also be furnished.

No. 36 Stand Blowpipe

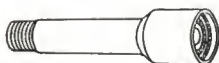




# Open Flame Burners

## Flame Retention Type

IT is frequently desirable to manifold burner heads which will burn out in the open, and for this purpose we supply brass tips similar to our "Super" Blowpipe heads (see page 127) with a standard thread connection. A single valve ratio control set as described on pages 158 and 159 or at least a Venturi Mixer as described on pages 156 and 157 is required for furnishing an adequate supply of air and gas properly premixed if good results are to be obtained.

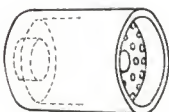


Burner No. for Manufactured Gas	Gas Cons. B.T.U./Hr. 525 B.T.U. Gas; 8" Mixture Press.	Burner No. for Mixed Natural or Bottled Gas	Gas Cons. B.T.U./Hr. 1050 B.T.U. Gas; *Optimum Mixture Pressure	Flame Similar to Blowpipe No.	Physical Dimensions	
					Overall Length Inches	Male Pipe Thread Conn.
879	1,820	879-N	2,625	000	2 1/4	1/8"
871	4,340	871-N	5,250	00	2 1/4	1/8"
657	7,560	657-N	10,500	0	2 1/4	1/8"
626	14,560	626-N	18,900	1	2 3/4	1/8"
622	34,160	622-N	52,500	2	2 3/4	3/8"
753	100,800	753-N	115,500	3	5 1/8	3/4"

\*Optimum—Highest operating capacity which gives ideal flame characteristics.

†No. 657-N Burner is 2 3/4" long overall.

## High Capacity Open Flame Burners



Burner tips for similar applications of cast iron for greater capacity are supplied with a female thread connection. These heads correspond to those used on our large Blowpipes (see page 129) and burn satisfactorily with natural, manufactured, mixed or bottled gas.

Burner No.	Flame Size		Max. Gas Cons. B.T.U./Hr. Based on 570 B.T.U. Mfd. Gas	Max. Air cu. ft./min. at 16 oz.	Inside Dia. Skirt on Head	Female Pipe Connection
	Dia.	Length				
*24	7/8"	8"	33,000	5.5	1 3/16"	1/4"
*24CA	7/8"	5"	15,000	2.5	1 3/16"	3/8" (Male)
*35H	1 1/4"	13"	45,000	7.5	1 1/16"	3/8"
36	2"	16"	80,000	13.5	2"	3/4"
37	3"	20"	250,000	41.5	2 1/2"	1 1/2"
37S	3"	20"	410,000	68.0	2 1/2"	1 1/2"
37T	H. R. Alloy Head		410,000	68.0	2 1/2"	2"
432A	4"	30"	530,000	88.0	3"	2"
432G	H. R. Alloy Head		530,000	88.0	3 1/8"	2 1/2"

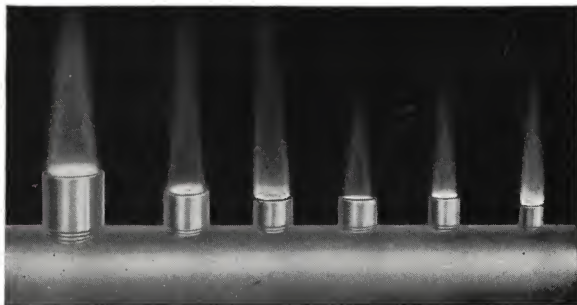
\*Made of either machine steel or alloy, as specified when ordering.





## Machlet Tips

Soft, mild focusflame burners which are perfectly steady and capable of exact adjustment.



422      64A      63      62      61      377

Machlet Tip No.	*Max. Gas Cons. B.T.U. Per Hr.		Max. Air Cu. Ft./ min. at 16 oz. Pressure	Thread Con- nection Pipe Size	Overall Length Inches	Std. Spacing of Tips in Manifold Inches
	Mfd. Gas 525 B.T.U.	Natural Gas 1050 B.T.U.				
422	15,750	4,000	.2	3/4	1 1/2	2
64-A	4,200	2,250	.5	1/2	1	1 3/8
†565	4,200	2,250	.5	1/8 (fem.)	1	1 3/8
63	2,625	1,000	.35	3/8	3/4	1 3/8
62	2,100	1,000	.3	3/8	3/4	1 3/8
61	1,575	750	.25	1/4	5/8	1
377	1,050	500	.15	1/8	9/16	1

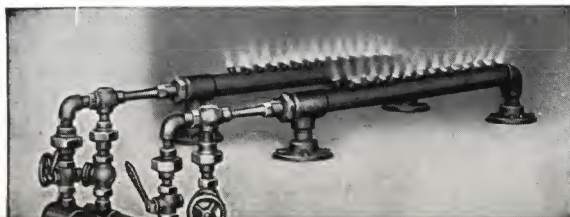
\*For mixed, bottled or other slow burning gases, calculate consumption from natural gas capacity above. Where desired, we can also supply a sleeve to fit over the tip which will double the gas consumption.

†Not illustrated. Flame characteristics same as—64-A.

**M**ACHLET TIPS (especially designed for use with air at 1 lb. per sq. in. and gas at line pressure) find numerous applications where temperatures below 1000°F. are required and where intensity and localization of the heat are undesirable.

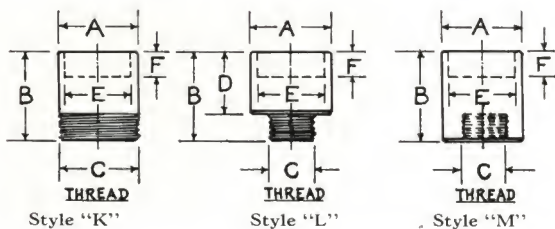
They are especially suitable for heating oil tempering pots, cleaning tanks, sand baths, tempering plates, Bakelite platens, rotary drums, and ovens of all kinds. Complete burners can be supplied with manifolds and Venturi Mixers or burner tips only can be furnished, in which case our Venturi Mixers per pages 156 and 157 should also be ordered if best results are to be obtained.

Double row Machlet tip burners with two rows of tips on a single manifold (included angle 60 to 120 deg.) for more heat in a limited space without overheating.





## Round Blast Tips



Blast Tip No.	Style	Dimensions				Max. Gas Consumption B.T.U. Per Hr.	
		A	B	C	D	525 B.T.U. Mfd. Gas	1050 B.T.U. Nat. Gas
422ND	M	1 1/16"	1 1/2"	3/8"	—	23,625	15,000
422N	K	1 1/16"	1 1/2"	3/8"	—	23,625	15,000
1542	L	7/8"	1 1/8"	1/4"	13/16"	18,375	9,000
1542A	L	7/8"	7/8"	1/4"	9/16"	18,375	8,000
†1542D	L	7/8"	7/8"	1/4"	—	22,000	14,000
565N	M	13/16"	1 1/4"	1/8"	—	7,875	4,000
64AN	K	13/16"	1"	1/2"	—	7,875	4,000
63DN	K	11/16"	1 1/2"	3/8"	—	6,300	2,500
63N	K	11/16"	3/4"	3/8"	—	6,300	2,500
63DNA	K	11/16"	1/2"	3/8"	—	4,725	2,500
552N	M	9/16"	1"	5/16"-27	—	3,675	1,500
61N	K	17/32"	5/8"	1/4"	—	3,675	1,500
377N	L	17/32"	9/16"	1/8"	—	3,675	1,500

†Burner has No. 18 drill size center hole.

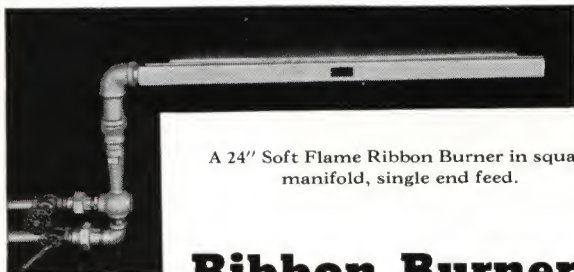
**R**OUND Blast Tips are intended and designed for applications requiring a greater heat intensity than can be obtained with Machlet Tips.

These burners are fabricated of heat-resistant alloy to give long life under severe operating conditions.

Round Blast Tips are recommended for silver soldering, heating baths, pots, ovens, etc.; or for other general heating applications requiring an intense, focusless flame.

A.G.F. Air-Gas Venturi Mixers as described on page 156 should be employed to supply the air-gas mixture to the burners.

Complete burner manifolds equipped with Round Blast Tips and Venturi Mixers, as illustrated on the preceding page can be supplied for your particular requirements.



A 24" Soft Flame Ribbon Burner in square manifold, single end feed.

## Ribbon Burners

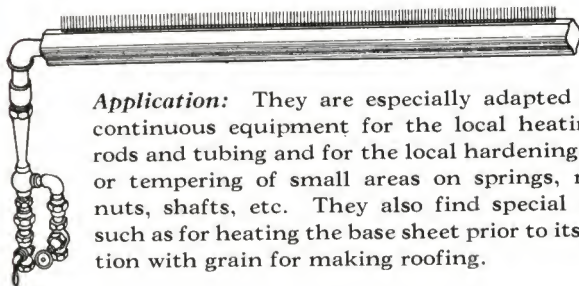
### SOFT FLAME

**Characteristics:** Soft flame Ribbon Burners produce an intense, even, focusless flame from a multitude of small outlets in the burner insert which is made from one piece bars and is of special construction.

**Application:** They are especially adapted for bending glass tubing for neon signs, laboratory work, heating wire for swaging and drawing in the lamp industry, and preheating lamp bulbs for shaping. They can be supplied in practically any length and width, however standard width is  $7/16"$ .

### SHARP FLAME

**Characteristics:** A thin, sharp, uniform, concentrated, knife-like flame is produced.



**Application:** They are especially adapted for use on continuous equipment for the local heating of glass rods and tubing and for the local hardening, annealing or tempering of small areas on springs, rods, bolts, nuts, shafts, etc. They also find special application such as for heating the base sheet prior to its impregnation with grain for making roofing.

### SPECIAL

These burners are also constructed in special design in lengths up to 12 and 24 feet for singeing felt materials, etc., and for heating calender rolls in the textile industry where the combustion space is extremely limited and high combustion capacity is essential. Write for details.





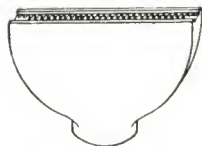
## Ribbon Burners



Sharp flame 4" Ribbon Burner in cast fishtail manifold with Venturi mixer, cocks and base. Supplied in lengths up to 12". Capacity:—15 CFH city gas per inch of burner.

### SHARP FLAME BURNERS

Cast fishtail manifold type are supplied in 1¼", 4", 6", 8" and 12" lengths. Other special lengths are also available. They are especially adapted for use on continuous equipment for example, for heating the ends of glass rods for forming a ball on them and also for the continuous local annealing or tempering of small areas on springs and similar parts.



No. 636H sharp flame Ribbon Burner 2½" flame for heating the teeth of hacksaw blades, etc.



No. 410B Soft flame Ribbon Burner for preheating in the lamp industry and for making short bends in tubing. Flame slot is 1½" long x ¼" wide.

### SOFT FLAME BURNERS

These burners in cast fishtail manifolds are available in 4", 6", 8" and 12" lengths. They give an intense uniform flame from end to end which is especially adapted for use in glass laboratories and neon sign plants for making smooth bends in comparatively small diameter tubing. "Stop-Offs" can be provided to give different flame lengths.



# Fish Tail Burners



420C

420D

104

332



81A

81B

81W

228

228F

Fish Tail Burner No. .... for Manufact Gas	Fish Tail Burner No. .... for Natural Gas	Flame Characteristics			Maximum B.T.U. Capacity Per Hr.		Male Threaded Con- nection
		Max. Lgth.	Focal Lgth.	Width at Focus	Mfd. Gas 525 B.T.U.	Natural* Gas 1050 B.T.U.	
228	228-NS	2"	1 1/2"	1 1/2"	2,285	1,500	1/4"-27
228-F	228-FNS	3"	3 3/8"	5 1/16"	2,285	1,100	1/4"-27
81-A	81-ANS	2 1/4"	3 3/4"	13 1/16"	6,820	3,050	1 1/8"
81-B	81-BNS	4"	3 3/4"	7 1/16"	5,515	3,050	1 1/8"
81-W	81-WNS	3 1/2"	1"	5 5/8"	4,720	3,625	1 1/8"
104	104-NS	2 1/2"	1"	13 1/16"	12,600	5,000	1 1/4"
332	332-NS	2 1/2"	7 7/8"	1 1/4"	15,750	4,395	1 1/4"
420-C	420-CNS	2 1/4"	7 7/8"	1 1/4"	12,600	4,750	1 1/4"
420-D	420-DNS	2 1/4"	7 7/8"	1 1/4"	10,370	5,625	1 1/4"
\$589-A	\$589-ANS	1 3/4"	1 7/8"	1 1/2"	2,675	1,940	1 1/4"-27
\$589-B	\$589-BNS	1 3/4"	1 7/8"	1 1/2"	3,915	2,100	1 1/8"
†775	.....	1 3/8"	5/8"	1 1/2"	1,830	955	1 1/8"-27
†775-F	.....	1 1/4"	1/2"	3/8"	1,170	670	1/4"-27

\*For mixed, bottled, or other slow burning gases, calculate consumption from natural gas capacity above. Specify type of gas when ordering.

†775 and 775F (not illustrated) are 5/8" overall height—otherwise respectively similar to 228 and 228F.

\$589A and 589B (not illustrated) have flame protected by alloy skirt 1/4" high—otherwise similar to 228.

**F**OR local hardening annealing and tempering, Fish Tail Burners are extensively used.

In their simplest application a number of them are mounted in a straight manifold. Work such as screws, bolts, etc., may be placed on a suitable support so that heating occurs over the desired area only.

For larger production requirements these burners are used in conjunction with a conveyor. If a straight chain conveyor is used the burners are mounted in a straight manifold and may fire either from below or above or both. If a rotor is used for conveying the burners may be mounted in a curved manifold. In Heating Machines of this type (see page 32) work may be fed, that is, production may be started without delay the moment the burners are lighted.

These burners are supplied for use with manufactured, natural, mixed or bottled gases, and air at one to two pounds per square inch pressure. A Venturi Mixer is required for premixing the air and gas.



3222      3202      3182      3171      3151      3131      3114

## Glass Fires

**I**NDIVIDUAL Glass Fires are an integral part of Cross Fires for application as described on page 137. They are also used for soldering cans in special machines, for the heating of glass rods for the manufacture of beads, Christmas tree ornaments, etc.

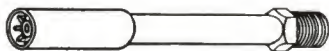
Burner No.	3222	3202	3182	§ 525	3171	3151	3141	3131	3114
Ctr. Hle, Drill Size	70	60	55	55	52	49	47	44	33
Lgth. of Flame, In.	2½"	5¾"	5"	5"	6½"	6½"	5¼"	4½"	5"
Gas Cons. Nat. Gas, B.T.U./Hr.	1,075	1,095	1,280	630	1,510	1,660	1,710	1,900	2,375
Approx. Max Air Req'd. C.F.M. at 16 oz. Pressure	.2	.2	.25	.1	.3	.3	.3	.4	.45

All burners have ⅛" male pipe thread conn.

§May also be used with addition of oxygen to air or straight oxygen and gas preferably not opposed as in cross-fires.

Any of these fires can be used with manufactured, mixed, natural, or bottled gas, especially when served by our improved Venturi Mixers. Air supply, preferably two pounds per square inch. Gas supply, line pressure. Higher pressures may be necessary because of small piping.

Standard lengths are 1", having no suffix letter, 2" and 3¼" with suffix letters "D" and "J", respectively.



When burners with bendable copper insert (for lining up) are desired, they take a second suffix letter "C." For example a No. 3181 Burner 3¼" long with copper insert is called No. 3181-JC. Insert burners are provided with a hexagon nut for ease in tightening up.





## Cross Fires

Five Way Cross Fire  
complete with Sliding  
Bases, Venturi Mixer and  
Needle Valves.



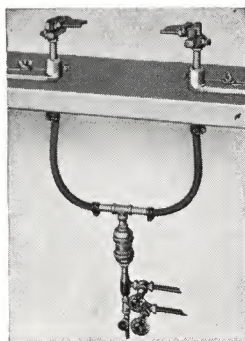
### Air, Gas Cross Fires

**C**Ross Fires are used on lamp and stem machines for making flares, shaping, sealing in, preheating, etc. They also find application for the heating of glass rods, for the manufacture of lenses, etc. Cross Fires are also used on a bench for manufacturing chemical glassware, neon light signs, etc. These burners are supplied to use any gas at line pressure with air pressure per the preceding page. They may be supplied with from 2 to 8 burner tips on each side, using any of the Glass Fires shown on the preceding page.

### Oxygen-Gas Cross Fires

For an extra concentration of heat on lamp and stem machines, we supply either oxygen-gas or oxygen-air-gas Cross Fire equipment. Our special heat-resisting alloy tips, as shown on page 141, are employed and equipped with a ball joint for accurate adjustment of the direction of each individual flame. When using the combination oxygen-air-gas, wherein oxygen is approximately 10%, burner tips No. 525 as shown on page 136 may be employed. A Fire Check prevents burning back into the gas supply line in the event of flashback.

**CAUTION:** In making up any oxygen-gas burner equipment, extreme care should be taken that there is no oil or grease inside of the fittings. In this way, flashbacks can be reduced to a minimum.





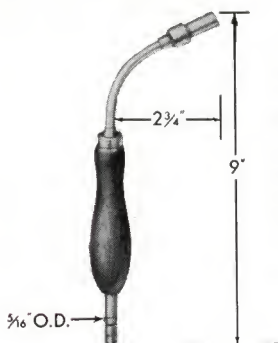
## Hand Torches

A.G.F. Hand Torches are sturdily constructed of brass tubing to permit bending for adjustment of burner spacing and yet having sufficient strength to withstand shop usage.

These opposed flame torches find many applications such as:

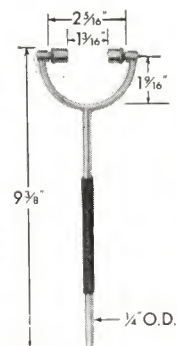
1. Sealing ampules.
2. Sealing off and welding on tubing for neon signs, laboratory glassware, etc.
3. Soft soldering and brazing of tubing, round pieces, etc.

For efficient operation, the use of a Venturi Mixer as described on pages 156 and 143 is recommended. Suitable rubber tubing can be furnished for connecting the Hand Torch and Venturi Mixer.



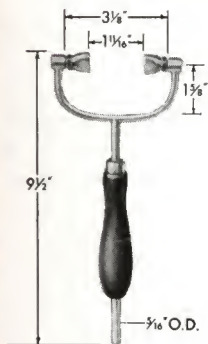
The No. 1258-A Hand Torch shown at left is normally supplied with a No. 3182 Glass Fire Tip as described on page 136. The No. 1258-A Hand Torch will accommodate any  $\frac{1}{8}$ " male threaded Glass Fires and Fishtail Burners as described on pages 136 and 135 or Oxygen-Gas Burners as described on pages 140 and 141. If a burner other than the No. 3182 is desired, please specify in the following manner: "No. 1258-A Hand Torch Frame complete with Burner No. ...."

The No. 412-N Hand Torch shown at right is normally supplied with two No. 9-F Burners. The No. 412 Hand Torch Frame will accommodate any  $\frac{1}{4}$ "-27 male threaded Glass Fires, No. 775 and No. 775-F Fishtail Burners, etc. or Oxygen-Gas Fishtail Burners and Tips as described on pages 140 and 141. If burners other than No. 9-F are desired, please specify in the following manner: "No. 412 Hand Torch Frame complete with Burners No. ...."



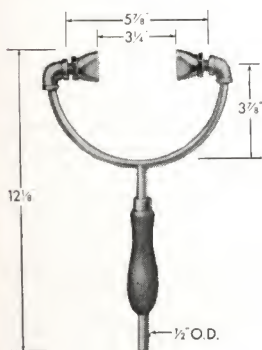
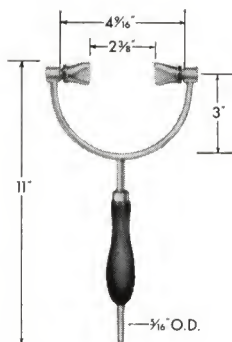


## Hand Torches (Cont'd)



The No. 659-N Hand Torch shown at left is normally supplied with two No. 228-NS Fishtail Burners as described on page 135. The No. 659 Hand Torch Frame will accommodate any  $\frac{1}{4}$ "-27 male threaded Fishtail Burners, Glass Fires or Oxygen Gas Burners as described on pages 135, 136, 140 and 141. If burners other than the No. 228-NS are desired, please specify in the following manner: "No. 659 Hand Torch Frame complete with Burners No. ...."

The No. 658-N Hand Torch shown at right is normally supplied with two No. 81-ANS Fishtail Burners as described on page 135. The No. 658 Hand Torch Frame will accommodate any  $\frac{1}{8}$ " male threaded Fishtail Burners, Glass Fires, or Oxygen Gas Burners as described on pages 135, 136, 140 and 141. If burners other than No. 81-ANS are desired, please specify in the following manner: "No. 658 Hand Torch Frame complete with Burners No. ...."



The No. 1022-N Hand Torch shown at left is normally supplied with two No. 420-CNS Fishtail Burners as described on page 135. The No. 1022 Hand Torch will accommodate any  $\frac{1}{4}$ " male threaded Fishtail Burners, Blast Tips, or No. 1081-A Oxygen Gas Fishtail Burners. If burners other than the No. 420-CNS are desired, please specify in the following manner: No. 1022 Hand Torch Frame complete with Burners No. ...."





# Oxygen-Gas Burners

## Oxygen Fishtail Burners

A.G.F. Oxygen-Gas Fishtail Burners are manufactured of heat-resistant alloy or brass, chrome plated, to give long life under severe operating conditions. For efficient operation, a Venturi Mixer as described on page 143 should be employed.



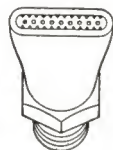
No. 1012



No. 15



No. 1253

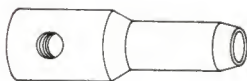


No. 1081-A

Burner No.	Flame Characteristics				Piloted Type	Center Holes		Male Thread Connection	B.T.U. Cap./Hr. 1050 B.T.U. Nat. Gas
	Max. L'gth.	Focal L'gth.	Width at Focus	Shape		No.	Drill Size		
15	5"	3/16"	7/16"	Parallel	No	5	#71	1/4"-27	4,200
15-D	2"	1/16"	3/8"	Parallel	No	5	#80	1/4"-27	1,155
1012	3 1/2"	1/4"	1 1/2"	Divergent	Yes	4	#64	1/4"-27	6,300
1012-F	7 1/2"	1/8"	3/8"	Parallel	Yes	5	#71	1/4"-27	3,675
1081-A	5"	1/4"	1"	Divergent	Yes	9	#62	1/4" i.p.s.	12,780
1253	7"	3/16"	5/8"	Parallel	No	10	#70	1/8" i.p.s.	5,250
1368	5"	1/8"	1 1/8"	Parallel	No	15	#71	1/4" i.p.s.	7,555
1621	5"	1/8"	1 5/8"	Parallel	No	22	#71	1/4" i.p.s.	11,000
1633	5"	1/8"	2"	Parallel	No	27	#71	1/4" i.p.s.	13,550

## Nozzle Mixing Burner

### No. 881-A



This burner is supplied especially for use with oxygen and hydrogen; however, in some cases, it is used with oxygen and manufactured or natural gas.

It produces a focal, sharp flame, and the center tube is accurately located to give concentricity.

Connections are 1/8" pipe thread at the back for oxygen and in the side for gas. Overall length 2 7/8", max. dia. 7/8". A fire check or mixer is not required.

This is also made in a smaller size known as No. 932A which has compression fittings instead of pipe tap.

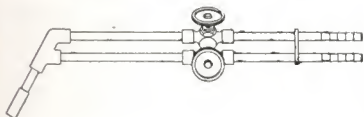


## Oxygen-Gas Burners (Cont'd)

WHERE the temperature and intensity of heat obtainable with air-gas burners is insufficient, oxygen-gas burners are used as, for example, in working Pyrex glass, for chemical glassware, radio tubes, etc., also for local flame hardening, welding copper wires, brazing metal tubes, etc. They are not intended for cutting.

NOTE:—ALL OXYGEN-GAS BURNER EQUIPMENT OF OUR MANUFACTURE HAS BEEN APPROVED BY THE NEW YORK CITY BOARD OF STANDARDS AND APPEALS, CAL. NO. 391-43-SA.

### Oxygen-Gas Blowpipes



A.G.F. No. 583 Oxygen-Gas Hand Blowpipes are equipped with needle valves and employ the venturi principle for proportionate pre-mixing of the oxygen and gas before it reaches the burner head.

These features permit operation of A.G.F. Oxygen-Gas Blowpipes at higher velocities than the ordinary nozzle mixing type. Oxygen-Gas Hand Blowpipe No. 583, when equipped with a correctly sized adapter can be supplied with any of the Oxygen-Gas Tips or Oxygen-Gas Fishtail Burners as described on the following pages. These versatile Blowpipes can also be operated on air and gas when equipped with proper adapters and supplied with No. 0-N, 00-N, 000-N or 1-EN Air-Gas Blowpipe Heads or other low capacity Air-Gas Burner Tips as described on the preceding pages. When ordering, please specify the burner model number desired in the following manner: "No. 583 Oxygen-Gas Blowpipe Frame equipped with Burner No. ...."

### Oxygen-Gas Tips†

Especially designed to eliminate backfiring and "blow-offs."



Style P



Style Q

Oxygen-Gas Tip No.	Center Hole Drill Size	Style	Length Overall	Thread Conn.	Mat'l.	B.T.U./Hr. Cap. at 12" w.c. mixture press. (1050 B.T.U.) (Nat. Gas)	Overall Flame Length
8	70	P	1 1/2"	1/4"—27	Alloy	1,050	2 1/2"
8A	70	Q	1 1/2"	1/4"—27	Alloy	1,050	3 1/2"
8D	68	P	1 1/2"	6-32 Fem.	Alloy	1,575	4"
8E	68	P	1 1/2"	6-32 Fem.	Alloy	2,100	5"
8G	68	P	1 1/2"	6-32 Fem.	Alloy	1,890	5"
693D	55	P	2"	1/8" Pipe	Alloy	3,675	6 1/2"
814D	49	P	2"	1/8" Pipe	Alloy	6,500	4 1/2"
1142A	58	Q	1 1/4"	1/8" Pipe	Brass	3,675	7"
1300A	55	Q	1 1/4"	1/8" Pipe	Brass	5,250	7"
1301A	49	Q	1 1/4"	1/8" Pipe	Brass	7,875	4 1/2"
1301B	31	Q	1 1/4"	1/8" Pipe	Brass	20,050	4 1/2"
†1301G	4-63	Q	1 1/4"	1/8" Pipe	Brass	7,875	5"
1635D	30	P	2"	1/8" Pipe	Alloy	20,000	3 1/2"
1636D	33	P	2"	1/8" Pipe	Alloy	16,000	4 1/2"
1637D	44	P	2"	1/8" Pipe	Alloy	9,925	4 1/2"
1638D	50	P	2"	1/8" Pipe	Alloy	6,300	5 1/2"

†For soldering and brazing applications.

‡See also No. 525 Burner on page 136.

(CONTINUED ON NEXT PAGE)



## Oxygen-Gas Burners (Cont'd)

### Special Burner Inserts



Air-gas or oxygen-gas Burner Inserts are specially designed for use in stem and head sealing machines as used by electric light bulb and electronic tube manufacturers. These burner inserts are obtainable in various styles and dimensions, with various sizes and locations of drillings, depending upon the desired application for same.

Burner Inserts are obtainable for use with air-gas, oxygen-gas, or combination oxygen-air-gas, in which case gas may be either manufactured or natural.

## Fire Checks



### No. 30-FC Fire Check

This Fire Check has been designed especially for use with individual burners and Hand Torches, etc. to prevent burning back into the gas supply line in the event of flashback. It is made from  $\frac{7}{8}$ " hex brass, is  $2\frac{5}{16}$ " in overall length and has  $\frac{1}{8}$ " or  $\frac{1}{4}$ " pipe thread connections at each end. The rated capacity of this Fire Check is 60 cubic feet of oxygen-gas mixture per hour.

### No. 75-FC Fire Check

This Fire Check has been designed to withstand unusually severe conditions as would be present when using same with Cross Fires or individual burner installations. To withstand the severe operating conditions, the No. 75-FC Fire Check contains a special designed heat-resisting alloy center core. Overall length of Fire Check is  $3\frac{1}{4}$ ", diameter 2", and has either  $\frac{3}{8}$ " or  $\frac{1}{2}$ " pipe connections at each end. The rated capacity is 150 cubic feet of oxygen-gas mixture per hour.



### No. 300-FC Fire Check

The No. 300-FC is similar in construction to the No. 75-FC. Overall length is  $5\frac{1}{4}$ ", diameter  $2\frac{1}{2}$ ", and has either  $\frac{3}{4}$ ", 1" or  $1\frac{1}{4}$ " pipe connections at each end. The rated capacity is 600 cubic feet of oxygen-gas mixture per hour.





## Oxygen-Gas Venturi Mixers

A.G.F. Oxygen-Gas Venturi Mixers have the same general physical characteristics and dimensions as A.G.F. Air-Gas Venturi Mixers described on pages 156 and 157. These mixers supply a consistently proportioned mixture of oxygen and gas to the burners to permit maximum and efficient operation. A.G.F. Oxygen-Gas Venturi Mixers and Oxygen-Gas Burners are rated for operation with oxygen at 5 pounds per square inch pressure. Suitable needle valves can be supplied for fine adjustment of oxygen-gas input settings.

An A.G.F. Fire Check as described on page 142 should be installed between the Oxygen-Gas Venturi Mixer and the burners. When ordering specify "Oxygen-Gas Venturi Mixer complete with Fire Check."

Please specify the following information when ordering Oxygen-Gas Venturi Mixers:

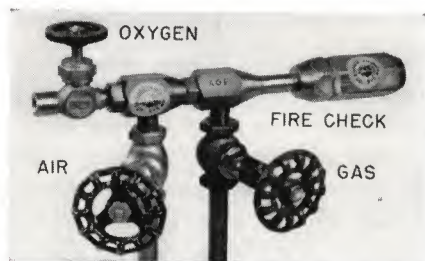
- (a) The total amount and model number of Oxygen-Gas Burners to be supplied by each Venturi Mixer. (If burner model number is unknown, specify the amount of burners, the amount and drill size of the center holes in each burner and whether or not the burners are of the piloted type.)
- (b) The type, b.t.u. value and pressure of gas to be used.
- (c) The oxygen pressure that will be available at the mixer.

### Caution

In making up any oxygen-gas burner equipment, extreme care should be taken that there is no oil or grease inside of the fittings. In this way, back flashing can be reduced to a minimum.



## COMBINATION OXYGEN-AIR-GAS VENTURI MIXERS



A.G.F. Combination Oxygen-Air-Gas Venturi Mixers are recommended for applications:

- (a) Not requiring the extreme heat and intensity of oxygen and gas.
- (b) To provide a lengthened focus of an oxygen-gas flame.
- (c) Where the heat produced by air and gas alone is insufficient.
- (d) To permit operation of air-gas burners at higher mixture pressures than are obtainable with air and gas only.

By employing A.G.F. Combination Venturi Mixers and suitable air-gas burners, air and gas can be used for preheating and oxygen can be added for the final heating.

Semi-needle valves are provided for controlling the air and gas, and a needle valve is provided for oxygen control.

An A.G.F. Fire Check as described on page 142 should be installed between the Combination Venturi Mixer and the burners. When ordering specify: "Combination Venturi Mixer Style. . . . complete with Fire Check."

A.G.F. Style OGA Combination Venturi Mixer is for use with piloted type oxygen-gas burners such as the Type "K" Oxygen-Gas Tips and Piloted Type Fishtail Burners.

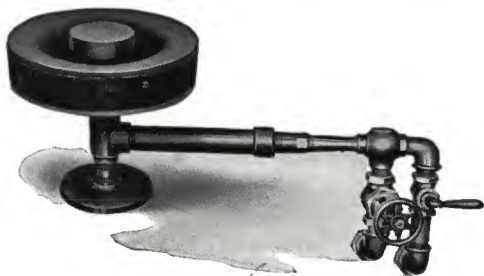
A.G.F. Style AGO Combination Venturi Mixer is for use with air-gas burner equipment and can be supplied to admix oxygen up to approximately 10% of the total mixture capacity of the burners.

The following information must be specified along with the style that is desired when ordering Combination Venturi Mixers:

- (a) The amount and model number of oxygen-gas or air-gas burners to be supplied by each Venturi Mixer. If the burner model is unknown, specify whether the burner is air-gas or oxygen-gas type and specify the amount of burners as well as the amount and drill size of the center holes in each burner.
- (b) The type, b.t.u. value and pressure of gas to be used.
- (c) The air pressure that will be available at the mixer.
- (d) The oxygen pressure that is to be used. (Minimum recommended pressure is 5 lbs. per square inch.)



## Soft Metal Burners



No. 34 Soft Metal Burner.

Our Soft Metal Burners are well suited for use under oil tempering pots, varnish kettles, cauldrons, autoclaves, etc., where temperatures of 1000°F. or less are required.

These burners have a wide range of turndown, which permits their operation at the maximum gas consumption given in the table below, or at a very much lower figure.

The burner holes are drilled at a tangential angle so that the flame has a swirling action, which is a most desirable feature because it increases the life of the pot.

The refractory ring and plug in the center of these burners becomes red hot, reflecting this heat upward against the pot and at the same time insuring complete combustion of the gas.

The outer brick ring can be omitted entirely and a metal band substituted for it where it is desired to install these burners in a limited space.

Soft Metal Burner No.	Dia. of Flame Inches	Dia. of Brick Ring Inches	Height of Burner Inches	Max. Gas Cons. B.T.U. Per Hr. Based on 1050 B.T.U. Nat. Gas	Max. Air Cu. Ft./Min. at 16 oz. Pressure	Supply Connections Std. Pipe Thread	
						Gas	Air
34	7 1/2	11	11 1/8	193,750	30	3/4	1
34 ES	7 1/2	11	11 1/8	262,500	42	1	1 1/4
34 DES	7 1/2	11	11 1/8	393,750	62	1 1/4	1 1/2

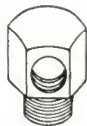




## Auxiliary Burner Equipment

### Hex Elbows

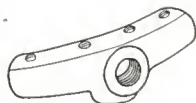
Special machine-made hexagon brass elbows are employed for accurate adjustment and alignment and for convenience, inasmuch as a wrench can be used on them. Connections are for  $\frac{1}{4}$ " pipe thread inlet and  $\frac{1}{4}$ " pipe thread outlet.



### Manifolds

Manifolds are designed for maximum efficiency, being of cast bronze with a tapered canal to insure uniform feeding and the same size of flame and concentration of the heat on the focal point from each burner.

Connections on top for hex elbows are  $\frac{1}{4}$ " pipe thread on  $1\frac{1}{2}$ " centers. For feeding,  $\frac{3}{8}$ " pipe thread connections are provided bottom and back, either of which may be used and the other plugged. Manifold radius— $5\frac{11}{16}$ ".



Supplied for 3, 4, 5, 6, or 8 tips. For two way fire, the center connection on three way manifold can be plugged.

### Sliding Bases

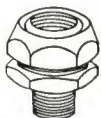
Sliding bases as illustrated on our Cross Fires, to permit adjusting them vertically and horizontally, are supplied to accommodate a  $\frac{3}{8}$ " vertical pipe nipple and with  $2\frac{1}{2}$ " bolt and wing nut for attaching to the table.

### Hose and Hose Connections

For Cross Fires, rubber hose  $\frac{1}{2}$ " i.d. to fit over  $\frac{3}{8}$ " piping and hose clamps are furnished.

For Hand Torches, rubber tubing  $\frac{1}{4}$ " i.d. is supplied.

### Ball Joints



A



B



C



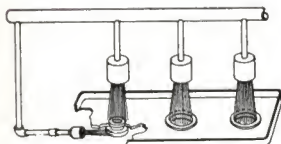
D

- A No. 500 Ball Joint, Ball  $\frac{9}{16}$ " dia. with  $\frac{1}{8}$ " female thread, a socket with  $\frac{1}{8}$ " male thread and a lock nut. No. 700 Ball Joint is identical except that a screen is provided in the ball.
- B No. 650 Ball. Ball  $\frac{1}{2}$ " dia. with screen and a  $\frac{5}{16}$ "—27 male thread and a washer for clamping onto a suitable manifold. The No. 750 Ball is identical except that the ball is  $\frac{3}{8}$ " diameter.
- C No. 800 Ball is  $\frac{3}{4}$ " in diameter and has a  $\frac{1}{4}$ " female thread.
- D No. 1770A Burner is  $1\frac{1}{8}$ " overall in length and has a  $\frac{5}{8}$ " diameter ball. The flame is equivalent to the No. 3182.
- A No. 800 Ball Joint, ball  $\frac{3}{4}$ " in diameter and has a  $\frac{1}{4}$ " female thread socket with  $\frac{1}{4}$ " male thread. Degree of tilt in any direction, 20 degrees.



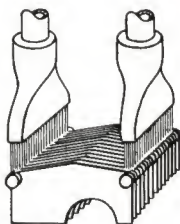
## TYPICAL BURNER APPLICATIONS

Fast, efficient operation without the use of scarce and expensive cylinder gases. Danger of over-heating is eliminated.



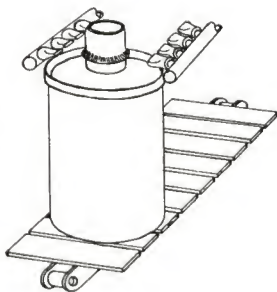
Special setups comprising various styles of heads all served by one mixer make it possible to braze numerous joints simultaneously.

Fish Tail Burner Heads speed up the job of soldering condensers. All joints are uniformly heated at one time.



Small Fish Tail Burners, either mounted in manifolds with a conveyor to carry the work past them, or arranged individually in a frame, concentrate the heat where it is required for speedy efficient brazing.

Fish Tail Burners in manifolds are supplied for conveyORIZED brazing or soldering on a high production basis. Flame lengths to 6 ft. can be supplied.



With Hand Torches using Fish Tail Burners, carbide tips can be brazed onto shanks, heat first being applied to the shank to preheat it thoroughly, surrounding the joint with soft, non-oxidizing flames to prevent scaling, before the final brazing operation is performed.



## When Compressed Air Only is Available

**B**LOWPIPES, burners and, in fact, all gas-fired industrial heating appliances are designed to use air at one to two pounds per square inch pressure with gas at 4" to 6" water column (2 to 3 ounces) per square inch pressure.

If such a supply of low pressure air is not available, devices can be furnished to permit the use of compressed air if it is available. Of course, better results will be had using air furnished in volume at the correct pressure because such air is clean and dry and the expense of compressing it is avoided.

Certain circumstances, however, make the use of compressed air expedient and in these cases selection should be made from the devices listed below.

Where the air consumption is nominal, the combination shown in Figure 1 should be employed. It consists of an expansion chamber with a dead weight relief valve, trap for water and oil and drain cock. The needle valve on this device is set when the appliance in question is operating at maximum capacity so that the relief valve is just lifted off its seat. The trap is particularly desirable for the operation of Blowpipes and burners and where maximum temperatures are required because of the water and oil carried in air.

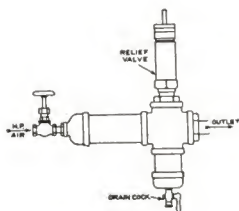


Fig. 1  
Air Pressure Reducer  
Max. Air 25 C. F. M.

For larger appliances, where the consumption of air is greater, a more economical device as shown in Figure 2 should be employed which entrains approximately 80% atmospheric air, using only about 20% of compressed air. It can be connected directly to the Venturi Injector on the appliance, regulation being by means of the needle valve in the compressed air line. Where pressures in the compressed air line vary, a Pressure Regulator should be used to regulate the pressure to a point below the lowest fluctuation of the compressor.

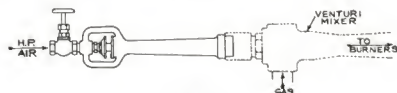


Fig. 2

H. P. Air Mixer No.	Connections Size, Inches		Capacity Cu. Ft. Per Min.	
	Inlet	Outlet	Input Compressed Air 60 Lb./Sq. In.	Output Air at 1 Lb./Sq. In.
H1	1/8	1/2	2	10
H2	1/8	3/4	4	20
H3	1/4	1	6	30
H4	3/8	1 1/4	11	55
H5	1/2	2	22	110





Furnace Burners

Burner Tunnels

Zero Governors

Venturi Mixers

Single Valve  
Ratio Sets

Installation

ACCESSORIES &  
FLOW METERS

USEFUL DATA

FUR. BURNERS  
& S.V.C. SETS

BLOWERS





## **Furnace Burners and Mixing Equipment**

**F**OR those who wish to design and build their own furnaces we offer burners, burner tunnels and mixing equipment, as shown on the following pages.

This equipment generally corresponds with that which we install on furnaces and heating machines manufactured complete by us and found to be most satisfactory through our many years of experience.

That experience has taught us that numerous small burners, each of limited capacity, give more uniform heating and greater uniformity than can be obtained by heating the same furnace with a few larger burners.

The furnace burners are of heat-resisting alloy to give long life with freedom from repairs and replacement such as may occur where cast iron burners are used because they oxidize and grow in service, not only changing input characteristics, but also interfering with the proper functioning of the mixing equipment.

The mixing units, namely, our single valve ratio sets, have been carefully designed and manufactured to give one valve regulation with a turndown ratio of 6 to 1 without appreciable change in the ratio of air to gas, this being an unusually wide operating range.

If burners, burner tunnels, and single valve ratio set or mixers are carefully selected and installed, excellent results will be obtained. Pages 160 and 161 have been included to assist you in making this selection.

**NOTE:** When complete sets of furnace burners are selected, capacities chosen may fall into two different diameter burners. If specified by customer, smaller capacity burners can be supplied in the same physical size (diameter and length) as the larger capacity burners, thus standardizing burner tunnel sizes, piping, etc.





## Furnace Burners Type A



Single Center Hole—No Pilots

**T**YPE A—Heat Resisting Alloy—For use only in melting furnaces and small cylindrical furnaces where the tangential firing of one burner tends to keep the next burner ignited, etc., etc., Recommended for operation at temperatures of 1350°F. or above.

Type A Furnace Burners can be turned down to approximately 25% of maximum input without back firing, provided the burners are properly installed in combustion tunnels no larger in diameter than the outside of the burner and not less than 3" long.

Burner No.	Dimensions			Max. Cap. B.T.U./Hr. 8" Manifold Pressure
	Dia.	Overall Length	Male Pipe Thread	
A-7-20	7/8"	2"	1/2"	25,000
A-7-22	7/8"	2"	1/2"	31,000
A-7-24	7/8"	2"	1/2"	36,000
A-7-26	7/8"	2"	1/2"	43,000
A-9-28	1 1/8"	2"	3/4"	50,000
A-9-30	1 1/8"	2"	3/4"	57,000
A-9-32	1 1/8"	2"	3/4"	65,000
A-9-34	1 1/8"	2"	3/4"	73,000
A-9-36	1 1/8"	2"	3/4"	82,000
A-9-38	1 1/8"	2"	3/4"	91,000
A-11-40	1 3/8"	2 1/2"	1"	101,000
A-11-42	1 3/8"	2 1/2"	1"	111,000
A-11-44	1 3/8"	2 1/2"	1"	122,000
A-11-46	1 3/8"	2 1/2"	1"	134,000
A-11-48	1 3/8"	2 1/2"	1"	145,000
A-11-50	1 3/8"	2 1/2"	1"	157,000
A-11-52	1 3/8"	2 1/2"	1"	171,000



## Furnace Burners Type B



Single Center Hole—Four Pilots

**T**YPE B—Heat Resisting Alloy—For use with high hydrogen, fast burning manufactured gases. Replaced by Type F Furnace Burners for slow burning natural gas, reformed natural gas, Butane or Propane as well as for better operational characteristics on manufactured gas.

Type B Furnace Burners can be turned down to approximately 20% of their maximum input when burning manufactured gas without back firing, provided the burners are properly installed in combustion tunnels no larger in diameter than the outside of the burner and not less than 3" long.

Burner No.	Dimensions			Max. Cap. B.T.U./Hr.	
	Dia.	Overall Length	Male Pipe Thread	8" Man. Pressure	6" Man. Pressure
B-7-45	7/8"	2"	1/2"	9,000	8,000
B-7-35	7/8"	2"	1/2"	10,000	9,000
B-7-10	7/8"	2"	1/2"	13,000	11,000
B-7-12	7/8"	2"	1/2"	16,000	14,000
B-7-14	7/8"	2"	1/2"	19,000	16,000
B-7-16	7/8"	2"	1/2"	23,000	20,000
B-7-18	7/8"	2"	1/2"	27,000	23,000
B-7-20	7/8"	2"	1/2"	32,000	28,000
B-7-22	7/8"	2"	1/2"	37,000	32,000
B-7-24	7/8"	2"	1/2"	43,000	37,000
B-9-26	1 1/8"	2"	3/4"	50,000	43,000
B-9-28	1 1/8"	2"	3/4"	56,000	49,000
B-9-30	1 1/8"	2"	3/4"	64,000	55,000
B-9-32	1 1/8"	2"	3/4"	72,000	62,000
B-9-34	1 1/8"	2"	3/4"	80,000	69,000
B-9-36	1 1/8"	2"	3/4"	89,000	77,000
B-11-38	1 3/8"	2 1/2"	1"	98,000	85,000
B-11-40	1 3/8"	2 1/2"	1"	108,000	94,000
B-11-42	1 3/8"	2 1/2"	1"	118,000	102,000
B-11-44	1 3/8"	2 1/2"	1"	129,000	112,000
B-11-46	1 3/8"	2 1/2"	1"	140,000	121,000
B-11-48	1 3/8"	2 1/2"	1"	152,000	132,000
B-11-50	1 3/8"	2 1/2"	1"	165,000	143,000
B-11-52	1 3/8"	2 1/2"	1"	177,000	153,000



# Furnace Burners

## Type F



Single Center Hole  
 $\frac{7}{8}$ " diameter size— 8 pilots  
 $1\frac{1}{8}$ " diameter size—10 pilots  
 $1\frac{3}{8}$ " diameter size—12 pilots

**T**YPE F—Heat Resisting Alloy—For use with manufactured, reformed natural, natural, Propane or Butane gases. The Type F Furnace Burner is the most versatile of A.G.F. Furnace Burners. It lights readily and retains the flame without difficulty burning any type of gas.

Type F Furnace Burners can be turned down to approximately 15% of their maximum input when burning natural and bottled gases and approximately 20% of maximum input when burning manufactured gas without back firing, provided the burners are properly installed in combustion tunnels no larger in diameter than the outside of the burner and not less than 3" long.

Burner No.	Center Hole Drill Size	Dimensions			Max. Cap. B.T.U./hr.	
		Dia.	Overall Length	Male Pipe Thread	8" Man. Pressure	6" Man. Pressure
F-7-50	50	$\frac{7}{8}$ "	2"	$\frac{1}{2}$ "	10,800	9,400
F-7-45	45	$\frac{7}{8}$ "	2"	$\frac{1}{2}$ "	11,300	9,800
F-7-35	35	$\frac{7}{8}$ "	2"	$\frac{1}{2}$ "	12,600	10,900
F-7-10	$\frac{5}{32}$ "	$\frac{7}{8}$ "	2"	$\frac{1}{2}$ "	16,000	14,000
F-7-12	$\frac{3}{16}$ "	$\frac{7}{8}$ "	2"	$\frac{1}{2}$ "	18,900	16,500
F-7-14	$\frac{7}{32}$ "	$\frac{7}{8}$ "	2"	$\frac{1}{2}$ "	22,500	19,600
F-7-16	$\frac{1}{4}$ "	$\frac{7}{8}$ "	2"	$\frac{1}{2}$ "	26,200	22,800
F-7-18	$\frac{9}{32}$ "	$\frac{7}{8}$ "	2"	$\frac{1}{2}$ "	30,700	26,800
F-7-20	$\frac{5}{16}$ "	$\frac{7}{8}$ "	2"	$\frac{1}{2}$ "	35,900	31,200
F-7-22	$\frac{11}{32}$ "	$\frac{7}{8}$ "	2"	$\frac{1}{2}$ "	41,500	36,100
F-7-24	$\frac{3}{8}$ "	$\frac{7}{8}$ "	2"	$\frac{1}{2}$ "	47,800	41,500
F-9-26	$\frac{13}{32}$ "	$1\frac{1}{8}$ "	2"	$\frac{3}{4}$ "	57,200	49,700
F-9-28	$\frac{7}{16}$ "	$1\frac{1}{8}$ "	2"	$\frac{3}{4}$ "	64,400	56,000
F-9-30	$\frac{15}{32}$ "	$1\frac{1}{8}$ "	2"	$\frac{3}{4}$ "	71,900	62,500
F-9-32	$\frac{1}{2}$ "	$1\frac{1}{8}$ "	2"	$\frac{3}{4}$ "	81,200	70,600
F-9-34	$\frac{17}{32}$ "	$1\frac{1}{8}$ "	2"	$\frac{3}{4}$ "	90,000	78,200
F-9-36	$\frac{9}{16}$ "	$1\frac{1}{8}$ "	2"	$\frac{3}{4}$ "	99,300	86,300
F-11-38	$\frac{19}{32}$ "	$1\frac{3}{8}$ "	$2\frac{1}{2}$ "	1"	111,600	97,100
F-11-40	$\frac{5}{8}$ "	$1\frac{3}{8}$ "	$2\frac{1}{2}$ "	1"	122,100	106,100
F-11-42	$\frac{21}{32}$ "	$1\frac{3}{8}$ "	$2\frac{1}{2}$ "	1"	134,300	116,800
F-11-44	$\frac{11}{16}$ "	$1\frac{3}{8}$ "	$2\frac{1}{2}$ "	1"	146,900	127,700
F-11-46	$\frac{23}{32}$ "	$1\frac{3}{8}$ "	$2\frac{1}{2}$ "	1"	160,900	139,900
F-11-48	$\frac{3}{4}$ "	$1\frac{3}{8}$ "	$2\frac{1}{2}$ "	1"	174,900	152,100
F-11-50	$\frac{25}{32}$ "	$1\frac{3}{8}$ "	$2\frac{1}{2}$ "	1"	188,500	163,900
F-11-52	$\frac{13}{16}$ "	$1\frac{3}{8}$ "	$2\frac{1}{2}$ "	1"	202,900	176,100





# Furnace Burners

## Type G



Four Center Holes

$\frac{7}{8}$ " diameter size—8 pilots  
 $1\frac{1}{8}$ " diameter size—10 pilots  
 $1\frac{3}{8}$ " diameter size—12 pilots

**T**YPE G—Heat Resisting Alloy—For use with manufactured, reformed natural, natural, Propane or Butane gases. The Type G Furnace Burner replaces the five center hole Type C Furnace Burner previously supplied. The Type G Furnace Burner has a shorter and bushier flame than the single center hole Type F Furnace Burner and is recommended for use where combustion space is limited.

Type G Furnace Burners can be turned down to approximately 15% of their maximum input when burning the natural and bottled gases and approximately 18% of maximum input when burning manufactured gas without back firing, provided the burners are properly installed in combustion tunnels no larger in diameter than the outside of the burner and not less than 3" long.

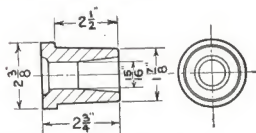
Burner No.	Center Hole Drill Size	Dimensions			Max. Cap. B.T.U./hr.	
		Dia.	Overall Length	Male Pipe Thread	8" Man. Pressure	6" Man. Pressure
G-7-50	50	$\frac{7}{8}$ "	2"	$\frac{1}{2}$ "	14,400	12,500
G-7-45	45	$\frac{7}{8}$ "	2"	$\frac{1}{2}$ "	16,200	14,100
G-7-43	43	$\frac{7}{8}$ "	2"	$\frac{1}{2}$ "	17,400	15,100
G-7-41	41	$\frac{7}{8}$ "	2"	$\frac{1}{2}$ "	18,700	16,300
G-7-39	39	$\frac{7}{8}$ "	2"	$\frac{1}{2}$ "	19,400	16,800
G-7-37	37	$\frac{7}{8}$ "	2"	$\frac{1}{2}$ "	20,200	17,600
G-7-35	35	$\frac{7}{8}$ "	2"	$\frac{1}{2}$ "	21,500	18,700
G-7-33	33	$\frac{7}{8}$ "	2"	$\frac{1}{2}$ "	22,200	19,300
G-7-31	31	$\frac{7}{8}$ "	2"	$\frac{1}{2}$ "	23,700	20,600
G-7-30	30	$\frac{7}{8}$ "	2"	$\frac{1}{2}$ "	25,900	22,500
G-7-9	$\frac{9}{64}$ "	$\frac{7}{8}$ "	2"	$\frac{1}{2}$ "	29,000	25,200
G-9-10	$\frac{5}{32}$ "	$1\frac{1}{8}$ "	2"	$\frac{3}{4}$ "	37,100	32,300
G-9-11	$\frac{11}{64}$ "	$1\frac{1}{8}$ "	2"	$\frac{3}{4}$ "	42,400	36,800
G-9-12	$\frac{3}{16}$ "	$1\frac{1}{8}$ "	2"	$\frac{3}{4}$ "	48,000	41,700
G-9-13	$\frac{13}{64}$ "	$1\frac{1}{8}$ "	2"	$\frac{3}{4}$ "	54,200	47,200
G-11-14	$\frac{7}{32}$ "	$1\frac{3}{8}$ "	$2\frac{1}{2}$ "	1"	65,600	57,100
G-11-15	$\frac{15}{64}$ "	$1\frac{3}{8}$ "	$2\frac{1}{2}$ "	1"	73,000	63,500
G-11-16	$\frac{1}{4}$ "	$1\frac{3}{8}$ "	$2\frac{1}{2}$ "	1"	80,900	70,400
G-11-17	$\frac{17}{64}$ "	$1\frac{3}{8}$ "	$2\frac{1}{2}$ "	1"	89,400	77,700
G-11-18	$\frac{9}{32}$ "	$1\frac{3}{8}$ "	$2\frac{1}{2}$ "	1"	99,200	86,200



## Burner Tunnels

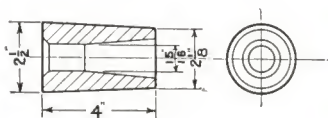
**F**OR use with our furnace burners, super refractory burner tunnels are especially recommended as this material will withstand temperatures in excess of 3100°F. and consequently there is no difficulty with it softening up and thus partially closing the burner tunnel. Their life is extremely long.

These tunnels can be installed simply and easily from outside of the furnace at nominal expense and they can also be replaced readily when and if this is necessary. The price is low and consequently it is more economical to use them than to ram up burner tunnels from a refractory material except where the burners are quite large in size. See page 160 for illustration of installation.

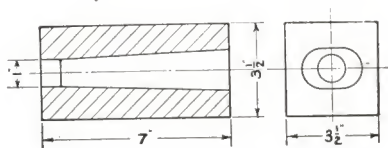


No. 2281 Tunnel. Supplied only for use in small furnaces with thin walls. The inner end of the tunnel should be approximately flush with the inside of the furnace wall.

No. 2288 Tunnel. For use with  $\frac{7}{8}$ " O. D. burners. Most extensively used. The required size of hole can be reamed into the brick and the burner tunnel is then cemented in place with its inner end approximately flush with the inside of the furnace wall. For additional details on installation, see page 160. No. 2288A Tunnel. For use with  $1\frac{1}{8}$ " O.D. burners. (See 2288 above)



No.  
2321 Tunnel



No. 2321 Tunnel. For use with  $\frac{7}{8}$ " O.D. burners. This burner tunnel is especially convenient where tunnels can be installed while bricking is in progress.

No. 2321A. For use with  $1\frac{1}{8}$ " O.D. burners (See 2321 above)

No. 2431—For  $\frac{7}{8}$ " O. D. burners. Similar to No. 2288, above, but 6" long and tapering from 3" to  $2\frac{1}{2}$ " O.D.

No. 2431A—For  $1\frac{1}{8}$ " O.D. burners. Other dimensions same as No. 2431.

No. 2508 Tunnel. For use with  $1\frac{1}{8}$ " O.D. burners,  $4\frac{1}{2}$ " sq. x 7" long. (Not illustrated)

No. 2508A Tunnel. For use with  $1\frac{3}{8}$ " O.D. burners. Other dimensions same as No. 2508.

An assembly comprising hard burned super refractory burner tunnel with sheet metal casing, outer cast iron housing for attaching to the furnace wall, and burner tip can also be supplied. Details upon request.

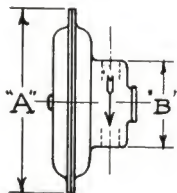


## Zero Governors

THIS zero pressure valve cancels variations in the gas line pressure and reduces it to atmospheric, thus allowing the Venturi Mixer to entrain gas in constant ratio to the amount of air passing through.

Our wide experience in the use and manufacture of burner equipment has resulted in this sensitive but rugged governor, an important component of our Single Valve Ratio Set, which is described on page 158.

The valve is designed to deliver gas at atmospheric pressure (plus or minus .1" water column pressure) to the mixer and yet have a minimum leakage. (All governors of the "zero" type have a slight leakage and are not intended for use as shut-off valves).



One zero governor may be used with two, three or even more Venturi Mixers, provided only that the distance between the zero governor and the mixers is kept to a minimum and does not exceed about 5' and that the line between them is of adequate size with a minimum number of bends. See page 161.

They are designed to operate satisfactorily with the gas supply at a pressure of 2" to 8" water column pressure. If the pressure is too high, the valve will tend to close, and the venturi mixer will be unable to entrain enough gas.

No.	Pipe Size	Capacity Cu. Ft. Gas/Hr.	Dimension	
			A	B
ZG1	3/4"	125	9 3/4"	5 1/4"
ZG2	3/4"	175	9 3/4"	5 1/4"
ZG3	3/4"	300	9 3/4"	5 1/4"
ZG4	3/4"	400	9 3/4"	5 1/4"
ZG5	1"	900	11 3/4"	7"
ZG6	1 1/4"	1300	11 3/4"	7"
ZG7	1 1/2"	1800	11 3/4"	7"

NOTE: It is absolutely necessary to specify the kind of gas when ordering.



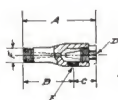


## Venturi Mixers

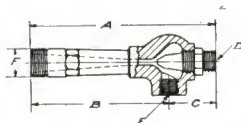
THESE Venturi Mixers are supplied to use air at from 12 ounces to 24 ounces per square inch pressure at the mixer with gas at 2" to 8" water column pressure, the air entraining the gas as it passes through the Venturi throat of the mixer. A gas booster is unnecessary unless pipe lines are undersize.

Careful design and manufacture insures maximum operating efficiency, that is, maximum suction on the gas, thorough mixing of the air and gas, and proportioning of the air and gas within limits. If, however, there is considerable variation in the gas line pressure, it will be reflected in the proportions of air and gas in the mixture going to the burners.

These Venturi Mixers form an important part of our Single Valve Ratio Sets where the gas pressure is reduced to atmospheric by means of the Zero Governor, per the preceding page, thus giving with them the maximum operating range with one valve control.



Style Y



Style Z

Venturi Mixer No. *	DIMENSIONS			PIPE SIZE			Style
	A	B	C	Air D	Gas E	Outlet F	
11	2 5/8"	1 13/16"	1 3/16"	1/8"	1/8"	1/8"	Y
12	3 7/16"	2 11/32"	1 3/32"	1/4"	1/4"	3/8"	Y
13	5 9/16"	3 5/16"	1 5/8"	3/8"	3/8"	1/2"	Z
14	6 7/8"	5"	1 3/16"	1/2"	1/2"	3/4"	Z
15	9 5/8"	7 3/8"	2 1/4"	3/4"	3/4"	1 1/4"	Z
16	12 1/4"	9 11/16"	2 7/16"	1"	1"	1 1/2"	Z
17	15 5/16"	12 5/16"	3"	1 1/4"	1 1/4"	2"	Z
18	18"	14 15/16"	3 1/16"	1 1/2"	1 1/4"	2 1/2"	Z

\*This No. indicates the body size only. When ordering, select according to capacity from table on next page.



## Venturi Mixers Cont'd.

On equipment where Single Valve Ratio Set is desired (see pages 158 and 159) and the burners are subdivided into two or more sections, one Venturi Mixer may be used on each section of burners with only one zero governor in the main gas line.

The capacity figures are based on one cubic foot of air per 130 B.T.U.'s, which is slightly on the reducing side and are based on using air at the pressures indicated to deliver an air-gas mixture at a manifold pressure of 8" water column.

Note: To find air capacity in cu. ft. per min., divide number below by 7800.

Mixer No.		GAS CAPACITY IN B.T.U. PER HR. at Various Air Pressures at Mixer			
Body No.	Injector No.	16 oz. Equiv. C.F.H. Nat. Gas			
		12 oz.	B.T.U.	20 oz.	24 oz.
11-69			700	800	900
11-63			1,050	1,260	1,580
11-55			2,200	2,460	2,680
11-51			3,700	4,100	4,500
11-45			5,300	5,930	6,470
*12-42			6,800	7,600	8,300
*12-37			9,000	10,000	11,000
12-33			10,600	11,900	13,000
12-31			12,000	13,440	14,650
13-8	11,200	13,000	12	14,500	15,900
13-10	17,700	20,500	20	23,000	24,900
13-12	25,500	29,500	28	32,800	36,000
*14-14	34,700	40,000	38	44,700	48,900
*14-16	45,200	52,200	51	58,300	63,900
*14-18	57,300	66,000	63	73,800	80,900
14-20	70,600	81,500	77	91,100	99,800
*15-22	85,400	98,500	94	110,100	120,600
*15-24	102,000	117,500	112	131,200	143,700
15-26	119,200	137,600	130	153,800	168,500
15-28	138,600	160,000	152	178,800	195,900
*16-30	159,100	183,600	175	205,200	224,800
16-32	180,800	208,700	198	233,300	255,600
16-34	204,100	235,600	224	263,460	288,500
16-36	229,100	264,400	251	295,500	323,800
*17-38	255,300	294,600	280	329,300	350,800
*17-40	282,800	326,400	310	364,900	399,700
17-42	311,900	360,000	342	402,400	440,900
17-44	342,100	394,800	375	441,300	483,500
17-46	373,400	430,900	409	481,700	527,700
*18-48	406,600	469,200	446	524,500	574,600
*18-52	477,800	551,400	524	616,400	675,300
1-56	554,600	640,000	608	715,500	783,800
18-60	635,700	733,600	697	820,100	898,500
18-64	723,500	834,900	793	933,400	1,022,500

\*Same injector capacity also supplied with next smaller number body.



## Single Valve Ratio Sets

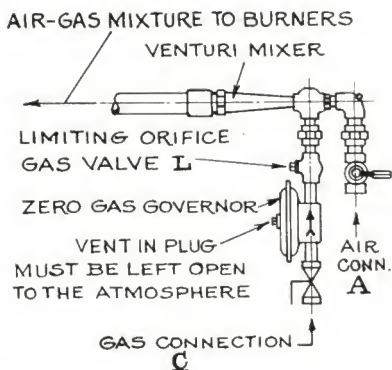
THESE sets comprise a Venturi Mixer as described on pages 156 & 157, a zero governor as described on page 155, with the necessary fittings and cocks, all sized according to the number and size of burners on the appliance where it is to be used.

They give one valve adjustment of the gas and air input over an unusually wide operating range with advantages as follows:

1. Assurance of the same furnace atmosphere at all times.
2. Higher efficiency.
3. Greater ease in hand regulation of the temperature.
4. Ease of adjustment to meet various furnace atmosphere requirements and maintenance of such atmosphere over the operating range.
5. Readily installed either on new or existing equipment and inexpensive to maintain.

Adjustment of the air to gas ratio is by means of the ratio cock (or valve when used with bottled gas) when equipment is first placed in operation. Unless the ratio of air to gas is to be altered frequently, we recommend removal of the handle of this cock after adjustment has been made.

Where automatic temperature control is employed, a control valve in the air line only is required, thus simplifying this feature. Any possibility of incorrectly opening or closing the air or gas ports (both necessary with two valve control) relative to each other is avoided. Air and Gas Mixture from Venturi is piped to burners.







# Single Valve Ratio Sets

SINGLE VALVE RATIO SET NUMBER			GAS CAPACITY IN B.T.U. PER HR. at Various Air Pressures at Mixer					GAS CONNECTION			Air Conn.	Outlet Conn.
City Gas 500-600 B.T.U.	Mixed & Nat. Gas 800-1200 B.T.U.	Bottled Gas 2400-3200 B.T.U.	12 oz. B.T.U.	16 oz.		20 oz. B.T.U.	24 oz. B.T.U.	City Gas	Mixed & Nat. Gas	Bottled Gas		
				B.T.U.	Equiv. C.F.H. Nat. Gas						Air Req'd. C.F.M.	
13-8-1/4	13-8-1/4	13-8-1/4	11,200	12	2	14,500	15,900	3/8"	3/8"	3/8"	1 1/2"	1 1/2"
13-10-1/4	13-10-1/4	13-10-1/4	17,700	20	3	23,000	24,900	3/8"	3/8"	3/8"	1 1/2"	1 1/2"
13-12-1/4	13-12-1/4	13-12-1/4	25,500	28	4	32,800	36,000	3/8"	3/8"	3/8"	1 1/2"	1 1/2"
*14-14-1/4	14-14-1/4	14-14-1/4	34,700	38	5	44,700	48,900	1/2"	1/2"	3/8"	3/4"	3/4"
*14-16-1/4	14-16-1/4	14-16-1/4	45,200	51	7	58,300	63,900	1/2"	1/2"	3/8"	3/4"	3/4"
*14-18-1/4	14-18-1/4	14-18-1/4	57,300	63	9	73,800	80,900	1/2"	1/2"	3/8"	3/4"	3/4"
14-20-3/8	14-20-1/4	14-20-1/4	70,600	77	11	91,100	99,800	1"	1/2"	3/8"	3/4"	3/4"
*15-22-1/2	15-22-1/2	15-22-1/2	85,400	94	13	110,100	120,600	1"	1/2"	3/8"	1 1/4"	1 1/4"
*15-24-1/2	15-24-1/2	15-24-1/2	102,000	112	15	131,200	143,700	1"	1/2"	3/8"	1 1/4"	1 1/4"
15-26-3/4	15-26-3/4	15-26-3/4	119,200	130	18	153,800	168,500	1 1/4"	1/2"	3/8"	1 1/4"	1 1/4"
15-28-3/4	15-28-1/2	15-28-1/2	138,600	152	21	178,800	195,900	1 1/4"	1/2"	3/8"	1 1/4"	1 1/4"
*16-30-1/2	16-30-1/2	16-30-1/2	159,100	175	24	205,200	224,800	3/4"	1/2"	1/2"	1 1/2"	1 1/2"
16-32-1/2	16-32-1/2	16-32-1/2	180,800	198	27	233,300	255,600	3/4"	1/2"	1/2"	1 1/2"	1 1/2"
16-34-1/2	16-34-1/2	16-34-1/2	204,100	224	31	263,400	288,500	1"	1/2"	1/2"	1 1/2"	1 1/2"
16-36-3/4	16-36-3/4	16-36-3/4	229,100	251	34	295,500	323,800	1"	3/4"	3/4"	1 1/2"	1 1/2"
*17-38-1/2	17-38-3/4	17-38-3/4	255,300	280	38	329,300	360,800	1"	3/4"	1 1/2"	2"	2"
*17-40-1/2	17-40-3/8	17-40-3/8	282,800	310	42	364,900	399,700	1"	3/4"	1 1/2"	2"	2"
17-42-1/2	17-42-3/8	17-42-3/8	311,900	342	47	402,400	440,900	1"	1"	1 1/2"	2"	2"
17-44-1/2	17-44-3/8	17-44-3/8	342,100	375	51	441,300	483,600	1"	1"	1 1/2"	2"	2"
17-46-1/2	17-46-1/2	17-46-1/2	373,400	409	56	481,700	527,700	1"	1"	1 1/2"	2"	2"
*18-48-1/2	18-48-1/2	18-48-1/2	406,600	446	61	524,500	574,600	1"	1"	1 1/2"	2 1/2"	2 1/2"
18-52-1/4	18-52-1/4	18-52-1/4	477,800	524	71	616,400	675,300	1 1/4"	1"	1 1/2"	2 1/2"	2 1/2"
18-56-1/4	18-56-1/4	18-56-1/4	554,600	608	82	715,500	783,800	1 1/4"	1"	1 1/2"	2 1/2"	2 1/2"
18-60-1/4	18-60-1/4	18-60-1/4	635,700	697	95	823,400	898,500	1 1/4"	1 1/4"	3/4"	2 1/2"	2 1/2"
18-64-1 1/2	18-64-1/2	18-64-1/2	723,500	793	107	933,400	1,022,500	1 1/2"	1 1/2"	3/4"	2 1/2"	2 1/2"

\*The Set Number consists of the mixer body number, the injector number, and the zero governor size. Sets marked with an asterisk can be supplied with the next smaller number mixer body and correspondingly smaller outlet connection and air connection.



## Burner and S.V.R. Set Selection & Installation

THE following should prove helpful in selecting suitable burners, tunnels and Single Valve Ratio Sets; however, it is not intended as a treatise on this subject.

1. Establish Holding Consumption from chart below:

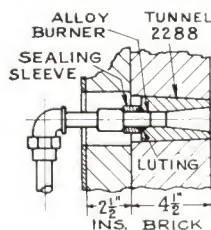
Kind of Lining	HOLDING GAS CONSUMPTION IN B.T.U./SQ. FT./HR. FOR DIFFERENT TYPES OF FURNACE WALLS AT VARIOUS TEMP'S.			
	1000°F.	1500°F.	1700°F.	2300°F.
4½" Fire Brick	1320	2750	3550	8000
4½" Fire Brick 2½" Silocel	315	730	930	2050
4½" Insulating Refractory	330	790	1070	2500
4½" Ins. Ref. 2½" Block Ins.	170	365	445	1080
4½" Ins. Ref. 4½" Block Ins.	—	250	310	720

Note: The figures in the table above take into consideration the "Available Heat" in gas at various temperatures i.e. allowing for the heat loss in the flue gases. Factors used were as follows: 70% available at 1000°F., 60% at 1500°, 56% at 1700°F., and 42% at 2300°F.

The outside furnace area in square feet times the above figure corresponding closest to your conditions plus an estimated figure for door losses etc., gives the holding gas consumption in B.T.U. per hour.

To select burners and mixing equipment, the maximum is usually fixed at three to four times the holding consumption. Using this figure, the number and sizes of burners may be determined from the data on pages 150-153.

Typical illustration of burner setting in furnace wall. Machlet furnace cement—see page 174—should be used around the burner at the coupling before it is positioned. A sealing sleeve held in by the burner coupling is used to hold the cement luting in place. Burner well should be open and of sufficient diameter for installing the burner tunnel. By allowing it to remain open, overheating of the burner is prevented. A union elbow in back of the burner facilitates installation.





## Burner and S.V.R. Set Selection and Installation

### 2. TO ESTABLISH SIZE AND NUMBER OF BURNERS

Locate burners on 5" to 6" centers on small furnaces up to one foot centers on large furnaces firing from both sides of the furnace and staggered, end burners to be close to the end walls and stronger to compensate for radiation losses.

Subdivide burners into suitable sections for manifolding and providing Single Valve Ratio Sets.

### 3. SELECTION OF SINGLE VALVE RATIO SETS

In selecting S. V. R. Set, use maximum B. T. U. figures for both burners and S. V. R. Sets as given in preceding tabulations. If to be arranged as shown in the illustration below the Venturi Mixers should be selected according to the maximum gas consumption of each section of burners and the zero governor according to the maximum consumption for the entire furnace.

### TUNNELS

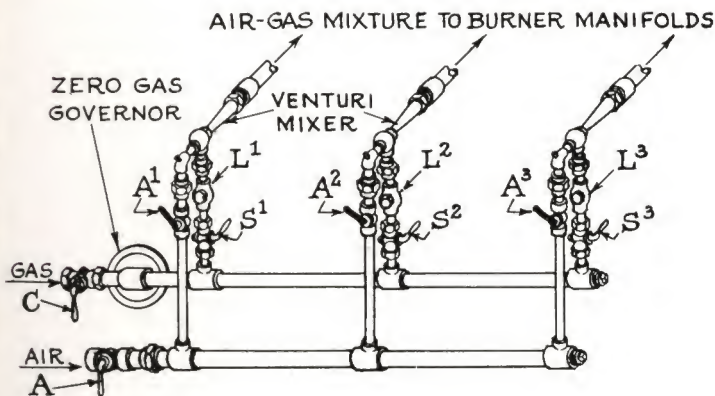
The correct tunnel for the burner selected will be obvious from the data on page 154. Under special circumstances, tunnels should be rammed up from a suitable refractory using a mandrel of the proper diameter.

### VENTS

Allow 1 square inch of vent per 30,000 B.T.U.'s maximum input.

### OBSERVATION AND LIGHTING HOLES

These should be conveniently located to serve their purpose and provided with suitable plugs or closures.



Typical piping diagram for furnace with burners in three sections. Two valves are provided in the gas line to each mixer, one for establishing the air-gas ratio which should be positioned and not changed thereafter. The A prime and S prime valves may be used for shutting off their respective burner sections if this is desired for any reason. The A prime valves may also be used for establishing the input to each section.







Spencer Turbo-Compressors  
with Direct Drive

Spencer Turbo-Compressors  
with V-Belt Drive

Blower with Universal Motor  
for Small Appliances.

Air Pressure Reducers

ACCESSORIES &  
FLOW METERS

USEFUL DATA

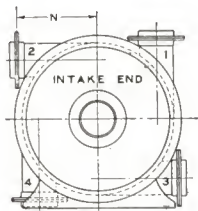
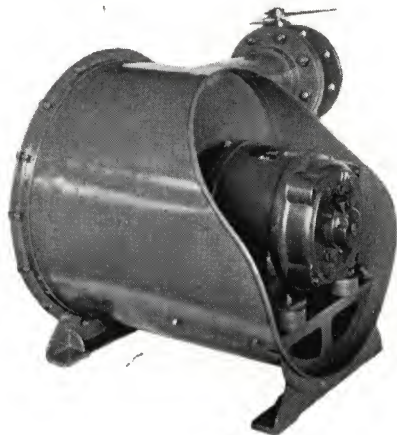
BLOWERS







# Spencer Turbo- Com- pressors



The No. 2 outlet is regarded as standard for our requirements, however, outlets Nos. 1, 3 or 4 can be furnished where desired. Positions apply only when facing intake end.

**F**OR maximum flexibility, that is, maximum gas input range in operating furnaces, the air supply pressure should be one pound or more at the furnace. This means that when line losses are allowed for, the blower should furnish air at  $1\frac{1}{4}$  pounds per square inch pressure or more.

The necessary volume must, in any event, be available for the furnace or furnaces which the blower is to supply.

Large numbers of Spencer installations have proven their dependability.

Tabulation below is only a partial listing of available sizes.

## 3500 R.P.M. TURBO-COMPRESSORS

HP.	PRESSURE—OZ. PER SQ. IN.							
	16		20		24		32	
	Cat. No.	Vol. cfm.	Cat. No.	Vol. cfm.	Cat. No.	Vol. cfm.	Cat. No.	Vol. cfm.
1	1001	110	1201	85	—	—	—	—
1½	1001½	160	1201½	120	1501½	75	—	—
2	1002	275	1202	185	1502	165	2002	100
3	1003	400	1203	350	1503	270	2003	180
5	1005	675	1205	550	1505	450	2005	325
7½	1007-H	1075	1207-H	825	1507-H	700	2007-H	470

A. C. machines 1 HP and larger are furnished with suitable hand starting device. D. C. machines are furnished with hand starting rheostat. A sleeve for connecting machine to the supply line and a pair of base pads are furnished as standard equipment.



## V-Belt Drive Spencer Turbo-Compressors

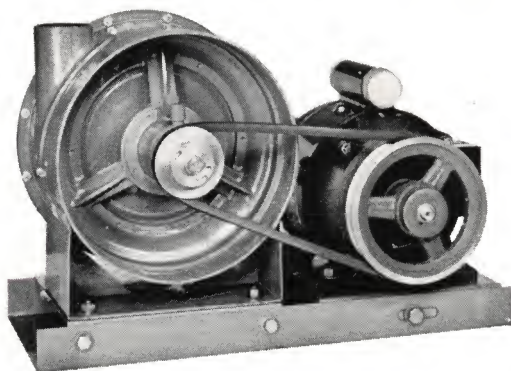
THESE units are recommended for continuous duty inasmuch as with the V-belt drive, 3500 r.p.m. motors can be employed to drive the turbine at 7000 r.p.m., thus obtaining the high peripheral speed necessary to deliver air at pressures up to 40 ounces and thereby give a wider operating temperature range on many furnace jobs.

The turbines on the small sizes are only 9" in diameter; on the larger sizes, 12" in diameter.

V-BELT DRIVE TURBO-COMPRESSORS

Unit No.	H.P.	C.F.M.	Pressure Oz./Sq. In	Length Inches	Height Inches	Width Inches
B- 50-12	$\frac{1}{3}$	50	12	$19\frac{1}{8}$	12	$9\frac{3}{4}$
B- 75-12	$\frac{1}{2}$	75	12	$23\frac{1}{4}$	$15\frac{7}{8}$	13
B-100-12	$\frac{3}{4}$	100	12	$22\frac{7}{8}$	$15\frac{7}{8}$	13
B- 50-16	$\frac{3}{4}$	50	16	$22\frac{7}{8}$	$15\frac{7}{8}$	13
B-100-16	1	100	16	24	$15\frac{7}{8}$	13
B- 80-20	1	80	20	$24\frac{1}{4}$	$15\frac{7}{8}$	13
B- 70-24	1	70	24	$32\frac{3}{4}$	19	$16\frac{1}{2}$
B- 50-32	$1\frac{1}{2}$	50	32	32	19	$16\frac{1}{2}$
B- 25-40	2	25	40	31	19	$17\frac{1}{4}$

Spencer B-80-20 Turbo Compressor





## Spencer Midget Turbo-Compressors



**S**PENCER Midget Compressors are supplied with a universal motor for 110 volt a.c. or d.c. current only. These compressors are not suitable for continuous duty; however, are entirely satisfactory for applications such as occasional operation of laboratory burners, melters, etc.

Spencer-Midget Compressors are built on the same principle as the larger Spencer Turbo Compressors of the direct connected type; however, the high speed universal motors require frequent inspection and brush replacement for satisfactory performance.

SPENCER MIDGET TURBO-COMPRESSORS

H. P.	PRESSURE—OZ. PER SQ. IN.									
	12		16		20		24		32	
	Cat. No.	Vol. cfm.	Cat. No.	Vol. cfm.	Cat. No.	Vol. cfm.	Cat. No.	Vol. cfm.	Cat. No.	Vol. cfm.
$\frac{1}{2}$	075 $\frac{1}{2}$ U	65	100 $\frac{1}{2}$ U	40	120 $\frac{1}{2}$ U	35	150 $\frac{1}{2}$ U	25	2001U 2001 $\frac{1}{2}$ U	35 50
$\frac{3}{4}$			100 $\frac{3}{4}$ U	55	120 $\frac{3}{4}$ U	45	150 $\frac{3}{4}$ U	35		
1 $\frac{1}{2}$			1001U	75	1201U	65	1501U	50		

## Spencer Gas Boosters

are available in various capacities. Write for Bulletin 903.





## When Compressed Air Only is Available

**B**LOWPIPES, burners and, in fact, all gas-fired industrial heating appliances are designed to use air at one to two pounds per square inch pressure with gas at 4" to 6" water column (2 to 3 ounces) per square inch pressure.

If such a supply of low pressure air is not available, devices can be furnished to permit the use of compressed air if it is available. Of course, better results will be had using air furnished in volume at the correct pressure because such air is clean and dry and the expense of compressing it is avoided.

Certain circumstances, however, make the use of compressed air expedient and in these cases selection should be made from the devices listed below.

Where the air consumption is nominal, the combination shown in Figure 1 should be employed. It consists of an expansion chamber with a dead weight relief valve, trap for water and oil and drain cock. The needle valve on this device is set when the appliance in question is operating at maximum capacity so that the relief valve is just lifted off its seat. The trap is particularly desirable for the operation of Blowpipes and burners and where maximum temperatures are required because of the water and oil carried in air.

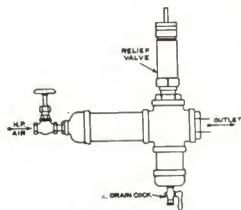


Fig. 1  
Air Pressure Reducer  
Max. Air 25 C. F. M.

For larger appliances, where the consumption of air is greater, a more economical device as shown in Figure 2 should be employed which entrains approximately 80% atmospheric air, using only about 20% of compressed air. It can be connected directly to the Venturi Injector on the appliance, regulation being by means of the needle valve in the compressed air line. Where pressures in the compressed air line vary, a Pressure Regulator should be used to regulate the pressure to a point below the lowest fluctuation of the compressor.

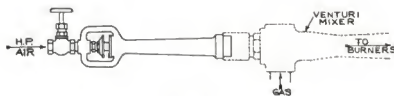


Fig. 2

H. P. Air Mixer No.	Connections Size, Inches		Capacity Cu. Ft. Per Min.	
	Inlet	Outlet	Input Compressed Air 60 Lb./Sq. In.	Output Air at 1 Lb./Sq. In.
H1	1/8	1/2	2	10
H2	1/8	3/4	4	20
H3	1/4	1	6	30
H4	3/8	1 1/4	11	55
H5	1/2	2	22	110



## Atmosphere Gas Mixing Cabinet

Flow Meters

Small Pyrometers

Automatic  
Temperature Controls

Regulating Valves

Machlet Furnace Cement

Pressure Gauges

Lighting Torches

Cocks & Valves







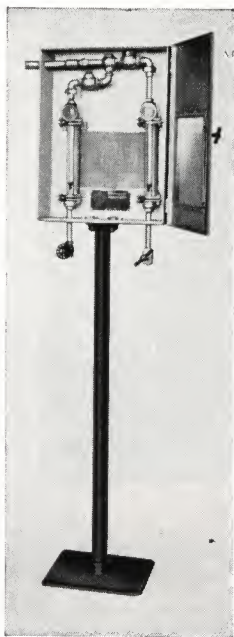
## Furnace Atmosphere Gas Mixer

USEFUL DATA

THIS unit achieves one purpose only, namely the pre-mixing of gases in definite volume and proportion for use as a retort or muffle atmosphere for a specific heat treatment.

Both gases should be at low pressures, namely, not exceeding one pound per square inch.

It is used especially for pre-mixing air and propane or manufactured gas and propane for carburizing, or for premixing ammonia and propane for "Ni-Carbing."



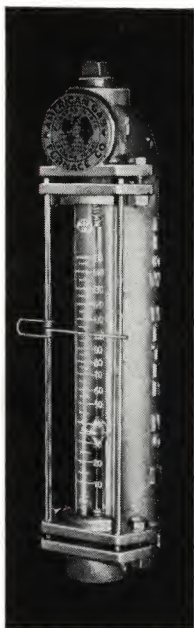
The unit comprises two or three Flow Meters with check valves and a Venturi Mixer in a cabinet with glass panel, also control valves, and is mounted on a stand at a convenient height for easy reading.

These units are usually made up to suit particular applications. However, in general, it may be said that they have capacities up to 600 cubic feet per hour of mixed gases.



## Flow Meters

Pat. 1,899,764 and 2,311,375



THESE Flow Meters are especially intended for measuring the flow of air and gases of all kinds to obtain control of heat-treating operations and other industrial processes not heretofore possible. Among the many applications are the measurement of the flow of atmosphere gases of all kinds, including carburizing gases, ammonia flow in nitriding, hydrogen flow, and measurement of the flow of fuel gases, including city gas, natural gases, bottled gases such as butane and propane, and mixtures of gas and air.

A float rises or falls in a Pyrex glass, calibrated, tapered tube, depending upon the flow of gas. The scale is direct reading in cubic feet per hour.

Flow Meters permit duplication of settings at any time with uniformity of results and a saving in gas.

Two or more are frequently used for proportioning the flow of different gases.

These Flow Meters must be mounted vertically; however, the unique design of the frame permits exceedingly flexible piping arrangements. As regularly supplied, the inlet connection is at the bottom of the flow meter. The outlet may be either at the top or the bottom, and supply or take-off lines may be run vertically or horizontally. A special type with

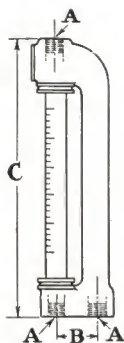
the frame inverted may also be supplied, in which case the inlet is at the top of the Flow meter, and the outlet at either the top or bottom.

With the exception of the 30X series, Flow Meters are calibrated for a pressure of 4" to 6" water column. The pressure drop in all A.G.F. Flow Meters with the exception of the 30X series varies from below 2" to 4" water column at full capacity. In the 30X series the pressure drop is 19" to 20" water column. Correction charts for other pressures are furnished, or, if desired, flow meters can be calibrated directly for other pressures at a small additional charge.

In addition to the units listed on the following page, special Flow Meters can also be supplied for practically all other industrial gases.

### DIMENSIONS OF FLOW METERS

Body Size (Pipe Connection "A")	B	C
$\frac{3}{8}$ "	$1\frac{1}{4}$ "	$11\frac{1}{2}$ "
$\frac{3}{4}$ "	$2\frac{1}{8}$ "	$14\frac{7}{16}$ "
$1\frac{1}{4}$ "	$2\frac{3}{4}$ "	$17\frac{1}{16}$ "



# Flow Meters

## FLOW METER NUMBER

Gas for which Flow Meter is Calibrated

Range Cu. Ft. Per Hr.	Hydrogen Sp. G. .07	Cracked Ammonia Sp. G. .29	Ammonia Sp. G. .59	Endo- thermic Sp. G. .604	City Gas Sp. G. .62	Nitrogen* Sp. G. .97	Air Sp. G. 1.00	Oxygen Sp. G. 1.10	Air-Propane (2 to 1) Sp. G. 1.18	Propane Sp. G. 1.55	Butane Sp. G. 2.06	Body Size (Pipe Con- nec- tion)
1/4-5	.....	.....	X05-59-3	X05-604-3	X05-62-3	X05-97-3	X05-100-3	X05-110-3	X05-118-3	X05-155-3	X05-206-3	3/8"
1/4-15	.....	X15-29-3	X15-59-3	X15-604-3	X15-62-3	X15-97-3	X15-100-3	X15-110-3	X15-118-3	X15-155-3	X15-206-3	3/8"
1-30	X15-7-3	X30-29-3	X30-59-3	X30-604-3	X30-62-3	X30-97-3	X30-100-3	X30-110-3	X30-118-3	X30-155-3	X30-206-3	3/8"
1-50	X50-7-3	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3/8"
1-75	.....	†X75-29-3	X75-59-3	X75-604-3	X75-62-3	X75-97-3	X75-100-3	X75-110-3	.....	.....	.....	3/8"
5-100	1X0-7-3	1X5-29-6	1X5-59-6	1X5-604-6	1X5-62-6	1X5-97-6	1X5-100-6	1X5-110-6	1X5-118-6	1X5-155-6	1X5-206-6	3/8"
5-150	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3/4"
10-150	1X5-7-3	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3/8"
20-200	2X0-7-3	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3/8"
10-350	.....	3X5-29-6	3X5-59-6	3X5-604-6	3X5-62-6	3X5-97-6	3X5-100-6	3X5-110-6	3X5-118-6	3X5-155-6	3X5-206-6	3/4"
15-450	4X5-7-6	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3/4"
20-600	.....	6X0-29-10	6X0-59-10	6X0-604-10	6X0-62-10	6X0-97-10	6X0-100-10	6X0-110-10	6X0-118-10	6X0-155-10	6X0-206-10	1 1/4"
25-600	6X0-7-6	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3/4"
150-1200	.....	.....	12X-59-10	12X-604-10	12X-62-10	12X-97-10	12X-100-10	12X-110-10	.....	.....	.....	1 1/2"
500-3000	.....	.....	30X-59-10	30X-604-10	30X-62-10	30X-97-10	30X-100-10	30X-110-10	.....	.....	.....	1 1/4"

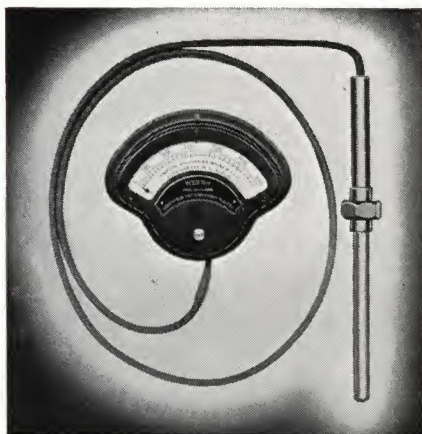
\*Also used for Carbon Monoxide.

†Range is from 5 to 75 c.f.h.





## Pyrometers



### No. 269-B

Scale range—0 to 2000°F.  
Instrument—black enamel finish,  $7\frac{7}{8}$ " by  $6\frac{1}{4}$ ".  
Scale length—4".  
Scale divisions—50°.  
Effective length of couple—1 ft.

Thermocouple—Chromel-Alumel, 5' long, 1' of which is beaded and fitted with a heat-resisting alloy protection tube  $\frac{7}{8}$ " o. d., balance of couple being insulated.

### No. 269

Scale—0 to 3000°F.  
Instrument—as above.  
Effective length of couple 6", 8" or 12".

Protection tube—Supertite porcelain  $\frac{1}{2}$ " o. d. Length of leads from instrument to end of thermocouple tube 5'.

Where the application does not warrant a high priced pyrometer or automatic temperature control, we supply the Model 269-B with Chromel-Alumel thermocouple or the No. 269 with Platinum-Rhodium couple, or, if a still lower priced instrument is required, the No. 301. These instruments are manufactured for us especially by the Weston Electrical Instrument Corporation.

### No. 301

Scale—0 to 2000°F.

Instrument, chrome plated,  $3\frac{1}{2}$ " diameter.

Scale length—2.36".

Scale divisions—50°.

Thermocouple — Chromel-Alumel 5' long, 1' of which is beaded and fitted with a heat-resisting alloy protection tube  $\frac{7}{8}$ " o.d., balance of the couple being insulated.





# Automatic Temperature Control

WITH the exception of experimental work and small tool room jobs where indicating pyrometers may suffice, automatic controls are today universally recommended, the type to be selected depending upon the degree of control required and application and whether a record is necessary.

## Millivoltmeter Control

Indicating millivoltmeter control with 6" scale is probably the cheapest automatic temperature control available.

## Potentiometer Control

These controls are usually considerably more accurate than millivoltmeter controls. Most have a 12" scale and a scale range selected to give wide open divisions for close control.

## Proportioning Control

With these instruments, the valve movement corresponds with the degree of correction required as compared with the two-position control where change in temperature results in the valves being opened or closed to predetermined positions which can be adjusted as desired.

## The Radiation Principle

Ordinarily, a thermocouple is used in the furnace to indicate the temperature. For especially quick response and applications where thermocouples will not stand up, the radiation principle is employed using a Thermopyle (number of extremely small thermocouples) outside of the furnace which sights on the work in the furnace or on the bottom of a tube extending into it.

Any standard make can be supplied at current prices.

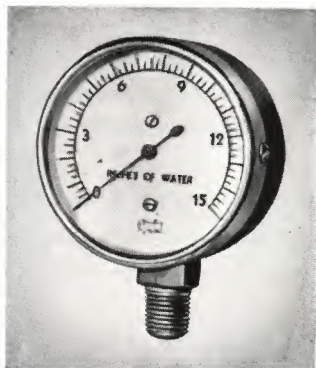


## Gauges

**N**O furnace is really complete without gauges to check and duplicate settings, especially manifold pressures.

### DIAL TYPE

These gauges are finished in black with easy reading black numerals on a white face. They are sturdily made and are equipped with a built in snubber to take shocks caused by a sudden rise in pressure. With these dial type gauges, there is no need to refill with water.



#### NO. DT-1

0-15" water column pressure, 3½" face. Used for reading manifold or gas line pressures.

#### NO. DT-2

0-60" water column pressure, 3½" face. Used for reading air line pressures, etc., such as generally used on our standard Single Valve Ratio System.

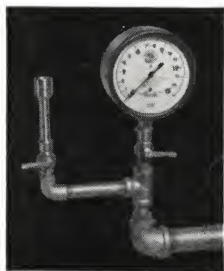
#### NO. DT-3

0-30" pounds, 2½" face. Used on high pressure gas systems.

## Tell-Tale Burner

For convenience in setting the air-gas mixture, we furnish Burner Tip and a cock.

This little unit is particularly desirable where it is difficult to observe the functioning of the burners and note the flame characteristics where the flame leaves the burner tunnel. By observing the flame characteristics at the base of the flame of this Tell-Tale Burner, the ratio cocks on our Single Valve Ratio Sets can be readily adjusted to give the desired flame characteristics and type of combustion.

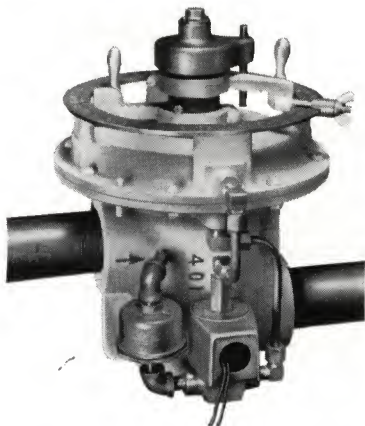






## A. G. F. Control Valve

For Use with  
Automatic  
Temperature  
Controllers



These control valves are rugged, simple in construction and readily adjustable.

No by-pass is required.

They are supplied for controlling the air only on the assumption that the furnace is provided with a Single Valve Ratio Set for regulation of the air-gas ratio.

The dial levers at the top fix the maximum and minimum travel of the valve stem and accordingly the input in the two positions.

The valve itself is actuated through its diaphragm, the air supply to which is controlled by a small solenoid valve which is actuated by the temperature controller. These valves will operate with a single or 2 contact holding type instrument. The intermittent type may not be used.

Capacity—1" pipe size—20 C.F.M. Air

Capacity—1¼" pipe size—40 C.F.M. Air

Capacity—1½" pipe size—60 C.F.M. Air

### Fuel Input Throttle

In addition, in many cases, these valves are provided with an Automatic Fuel Input Throttle.

This device permits setting the furnace for maximum fuel input while coming up to temperature and then automatically reducing this maximum input to a predetermined smaller input after the furnace first attains operating temperature.



## **Matchlet Furnace Cement**

**F**OR general repairs Matchlet Furnace Cement is recommended because of the ease with which it can be applied and the satisfactoriness of repairs made with it.

It is an especially compounded asbestos-fire clay mixture and will withstand excessive temperature and bond firmly with the original fire brick lining.

Another highly desirable characteristic of this cement is the fact that it does not shrink to any appreciable extent after it has been heated.

It is supplied dry and should be thoroughly mixed with water to the consistency of putty for application. When properly applied it holds fast, is highly refractory and has negligible shrinkage.

We recommend that you keep a supply on hand at all times. It comes in 10, 25 and 100 pound bags.

### **Instructions for Using**

1. The approximate amount of cement which is required for the repair should be placed on a board or flat surface for mixing.
2. When shipped this cement is thoroughly mixed. If it does not appear to be uniform in composition because of settling out of the various ingredients, it is advisable to mix while still dry. Water should then be added and mixing continued until the cement is slightly drier than putty. Mixing should be thorough for best results.
3. Lining should be cold and clean before cement is applied.
4. The surfaces where cement is to be applied should be thoroughly wet down with a suitable brush.
5. Where possible, undercuts should be provided to help hold the cement in place.
6. Cement should be thoroughly rammed in.
7. After the cement has been rammed in it should be wet down with a suitable brush with water. If a glaze is desired use borax water (approximately one tablespoonful dissolved in one pint of water).
8. Dry slowly for as long as practical before applying heat and then increase the heat very gradually.

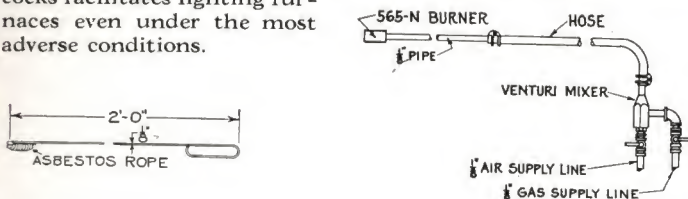


## Lighting Torches

A good lighting torch is an essential for convenient lighting of gas furnaces.

We are prepared to supply either of the styles shown below. The wire lighter with oil soaked asbestos rope tip is perfectly satisfactory for small furnaces.

The premix lighting torch consisting of a No. 565-N flame retention alloy burner,  $\frac{1}{8}$ " pipe of the desired length, rubber hose of the required length and a Venturi Mixer complete with cocks facilitates lighting furnaces even under the most adverse conditions.



## Cocks and Valves

FOR the convenience of our customers we keep available a stock of dependable standard cocks, globe valves and needle valves. These are the same as used on our standard single valve ratio sets.

**COCKS**—Standard gas type for use on low pressure air lines. Full open in  $90^\circ$  position.

**GLOBE VALVES**—Standard type for pressures up to 125 P.S.I.

**NEEDLE VALVES**—An inexpensive valve with tapered metal to metal seat. For pressures up to 95 P.S.I. These are used on our S.V.R. Sets to adjust the ratio of gas to air when using higher B.T.U. gases and a finer adjustment is desired.

Information on cocks and valves other than listed below may be had on request.

Pipe Size	Cock No.	Globe Valve No.	Needle Valve No.
$\frac{1}{8}$ "	C1	—	N1
$\frac{1}{4}$ "	C2	G2	N2
$\frac{3}{8}$ "	C3	G3	N3
$\frac{1}{2}$ "	C4	G4	N4
$\frac{3}{4}$ "	C5	G5	N5
1"	C6	G6	—
$1\frac{1}{4}$ "	C7	G7	—
$1\frac{1}{2}$ "	C8	G8	—
2"	C9	G9	—







"Ni-Carb"—A process for surface hardening.

Numbering Systems

Functions of the alloying elements in medium and high carbon steel.

Carburizing Data

Hardness and Tensile  
Conversion Tables

Temperature Conversion Table

Data on Various Materials

Conversion Factors

Capacity of Pipes, Air and Gas

Chart of Comparative Fuel Prices

Heat Content of Various Materials

Pressure Conversion Chart

Heat Colors

Temper Colors

Number of Small Circles in a Larger Circle

Suggested Small Shop Layout

Suggestions for Auxiliary Equipment

Map Showing Location of American Gas  
Furnace Co.







## **"Ni-Carb"**

Pat. 1,995,314 & 2,188,266

**"NI-CARBING"** is a surface hardening process originally developed by us in the early 1930's, which is a combination of nitriding and carburizing that produces a thin, hard case very quickly.

The treatment is carried out in a gas atmosphere consisting essentially of a carbon-rich gas and ammonia. The exact mixture of gases, the temperature, the time cycle, etc., can be varied according to the surface requirements. These conditions will also be influenced by the composition of the steel, nature of the parts, etc.

The actual treatment can be followed either by cooling in the treating gas atmosphere, or by a quench, depending upon the core properties required, full hardness of the case being obtained regardless of the method of cooling.

The temperatures employed are, comparatively speaking, quite low.

The process can be carried out in either rotary retort furnaces of the continuous or batch type or in full muffle reciprocating controlled atmosphere furnaces, belt conveyor furnaces with full muffle, etc. The choice of equipment will depend upon the nature of the work, production requirements and case depth.

It has a number of advantages which may be briefly enumerated as follows:

1. A hard surface which is highly resistant to corrosion and oxidation, whether the work is quenched or slow cooled.



## **"Ni-Carb" (Cont'd)**

Pat. 1,995,314 & 2,188,266

2. A hard surface which has what might be termed "tough hardness." The case adheres very tightly to the core with practically no tendency towards exfoliation.

3. Reduction in the amount of distortion, especially where parts are cooled in the treating gas atmosphere.

4. This process can be used on practically any grade of steel, steel alloys, also on steel castings, some cast iron and malleable iron.

5. This is a gas process. It requires no bath such as cyanide or other salts with their attendant disadvantages.

6. Uniformity of results.

7. Results can be duplicated without danger or fear of exhaustion of a bath.

8. Low cost.

9. Work which has been "Ni-Carbed," when polished, has the appearance of nickel or chrome plating (polished), but unlike nickel plating it is hard. Being a surface alloy, it does not flake off.

10. When polished, such work can be given all the various temper colors such as straw, brown, blue, etc., by means of temper heats and still retain its original degree of hardness.

11. Elimination of the washing which is necessary on cyanide hardened parts. It is particularly difficult to remove cyanide adhering to the threads of screws, bolts and nuts, blind holes, etc., which, if allowed to remain, causes corrosion.



## TABLE OF FUNCTIONS OF THE ELEMENTS

Principal Effects in Medium or High Carbon Steel

Alloy Element	To Increase Harden- ability	To Strengthen Ferrite	To Form Carbides; Decreasing Creep. Restraining Grain Growth	To Form Oxide Particles to Restrain Grain Growth
Mn	Strong	Strong	Mild	Weak
Si	Moderate	Strong	No	Moderate
Cr	Strong	Moderate	Moderate	Weak
Ni	Moderate	Strong	No	No
Mo	Moderate*	Weak	Strong	Weak if any
W	Moderate*	Weak	Strong	Weak if any
V	Mild*	Weak	V. strong	Prob. strong
Ti	Weak	Weak	V. strong	Prob. strong
Co	Weak	Strong	V. Weak	No
Al	Moderate	Strong	No	Strong
Zr	Prob. weak	Weak	Moderate	Strong
Cu	Mild	Moderate	No	No

\*These designations refer to the behavior in steels as usually heat-treated.

It should be noted that Mo, W and V when actually dissolved in Austenite greatly increase hardenability.

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## A.I.S.I. NUMERICAL DESIGNATION OF GRADES

The prefix letters indicate the method of steel manufacture as follows:

- A—Basic open hearth alloy steel.
- B—Acid Bessemer carbon steel.
- C—Basic open hearth carbon steel.
- C-B—Either acid Bessemer or basic open hearth carbon steel at the option of the manufacturer.
- D—Acid open hearth carbon steel.
- E—Electric furnace steels of both carbon and alloy types.





## A.I.S.I. Numerical Designation of Grades (Cont'd.)

The last two digits are intended, as far as feasible, to indicate the approximate middle of the carbon range, i. e., 21 represents a range of 0.18 to 0.23%. It is necessary to deviate from this rule and to interpolate numbers in the case of some carbon ranges and for variations in manganese, sulphur, chromium or other elements. The first two digits of the four numeral series for the various grades of alloy steel and their meaning is as follows:

<i>Series Designation</i>	<i>Types and Classes</i>
10xx	Basic and acid open-hearth and acid Bessemer carbon steel grades, non-sulphurized and nonphosphorized.
11xx	Basic open-hearth and acid Bessemer carbon steel grades, sulphurized but not phosphorized.
12xx	Basic open-hearth carbon steel grades, phosphorized.
13xx	Manganese 1.60 to 1.90 per cent.
23xx	Nickel 3.50 per cent.
25xx	Nickel 5.00 per cent.
31xx	Nickel 1.25 per cent—Chromium 0.65 per cent.
33xx	Nickel 3.50 per cent—Chromium 1.55 per cent.
40xx	Molybdenum.
41xx	Chromium-Molybdenum.
43xx	Nickel-chromium-molybdenum.
46xx	Nickel 1.65 per cent—Molybdenum 0.25 per cent.
48xx	Nickel 3.25 per cent—Molybdenum 0.25 per cent.
51xx	Medium chromium.
52xxx	Chromium, high-carbon.
61xx	Chromium-vanadium.
86xx	Nickel 0.55 per cent—Chromium 0.50 per cent—Molybdenum 0.20 per cent.
87xx	Nickel 0.55 per cent—Chromium 0.50 per cent—Molybdenum 0.25 per cent.
92xx	Manganese 0.80 per cent—Silicon 2.00 per cent.
93xx	Manganese 0.45 to 0.65 per cent—Nickel 3.00 to 3.50 per cent—Chromium 1.20 per cent—Molybdenum 0.11 per cent.



## A.I.S.I. Numerical Designation of Grades (Cont'd.)

<i>Series</i>	<i>Types and Classes</i>
<i>Designation</i>	
94xx	Manganese 0.95 to 1.15 per cent—Silicon 0.30 per cent— Nickel 0.45 percent—Chromium 0.40 per cent— Molybdenum 0.12 per cent.
95xx	Manganese 1.35 per cent—Silicon 0.50 per cent— Nickel 0.55 per cent—Chromium 0.50 per cent— Molybdenum 0.12 per cent.
96xx	Manganese 1.35 per cent—Silicon 0.50 per cent— Chromium 0.50 per cent.
97xx	Manganese 0.65 per cent—Silicon 0.30 per cent— Nickel 0.55 per cent—Molybdenum 0.20 per cent.
98xx	Manganese 0.80 per cent—Silicon 0.30 per cent— Nickel 1.00 per cent—Chromium 0.80 per cent.



## Approx. Critical Temperatures of Various Steels

STEEL	AC <sub>1</sub> Deg. F.	AC <sub>1</sub> Deg. F.	AC <sub>1</sub> Deg. F.	AR <sub>1</sub> Deg. F.	AR <sub>1</sub> Deg. F.	AR <sub>1</sub> Deg. F.
C1010	1350	1405	1605	1570	1400	1255
C1015	1390	1410	1560	1510	1395	1390
C1020	1350		1540	1470		1340
C1022	1360		1530	1440		1300
C1030	1350	1405	1495	1395	1405	1250
C1040	1340		1445	1350		1250
C1050	1340		1420	1320		1250
C1060	1355		1400	1300		1250
C1080	1350		1370	1285		1250
C1095	1350		1365	1320		1265
C1117	1345		1540	1450		1340
C1118	1330	1420	1515	1385	1370	1175
C1141	1310		1400	1340		1210
A1330	1325		1480	1340		1160
A1340	1340		1420	1195		1160
A1350	1310		1400	1255		1105
A2317	1300	1350	1440	1350	1260	1100
A2330	1280		1360	1355		910
A2340	1280		1360	1180		1060
A2515	1250	1335	1420	1220	1140	825
A3115	1355	1400	1500	1470	1380	1240
A3135	1340		1445	1300		1220
A3140	1360	1420	1265			1200
A3150	1355		1380	1275		1215
A3240	1335		1425	1280		1240
A4032	1360		1500	1400		1230
A4042	1320		1410	1340		1210
A4047	1310		1400	1320		1200
A4063	1405		1460	1325		1270
A4068	1360		1390	1220		1190
A4130	1400	1435	1510	1400	1395	1305
A4140	1395		1450	1330		1280
A4150	1390		1450	1290		1245
A4340	1350		1415	890		720
A4615	1335	1400	1485	1400	1320	1200
A4640	1325		1400	1220		275
A5140	1370		1440	1345		1280
A5150	1330		1420	1280		1220
E52100	1340		1415	1315		1280
A6120	1410	1460	1545	1440	1380	1300
A6145	1390		1450	1375		1290
A6152	1395		1445	1315		1290
NE8620	1340		1530	1415		1270
NE8630	1365		1465	1335		1205
A8720	1380		1520	1400		1200
A8740	1370		1435	1265		1160
A8750	1325		1390	1230		910
A9255	1410		1480	1330		1273
A9261	1440		1490	1345		1318
E9310	1350		1480	1210		810
NE9420	1340		1510	1390		1270
NE9430	1360		1430	1240		1190
A9440	1360		1450	1290		1215
NE9450	1365		1430	1245		1225
NE9540	1360		1450	1320		1200
A9763	1335		1400	1250		1220
A9840	1370		1430	1260		770
A9850	1355		1420	860		750

The majority of the data above has been taken from the A.S.M. 1939 Handbook, other from various sources.



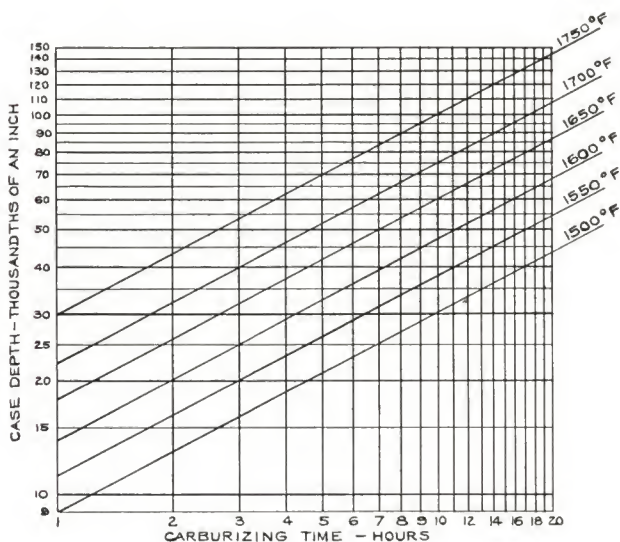


## The ABC of Stainless Steel

All stainless steels can be classified into one of the groups A, B, or C. This chart will therefore tell the general characteristics of any stainless steel. The exact properties may be varied somewhat by special elements such as manganese, silicon, copper, nickel, titanium, sulphur, selenium, etc.

Courtesy of Carpenter Steel Co.

GROUP	GROUP A	GROUP B	GROUP C
Analysis	All straight chromium steels in which % chromium minus 17 x % carbon = less than 12.5 % This group is magnetic	All straight chromium steels in which % chromium minus 17 x % carbon = more than 12.5 % This group is magnetic	All chrome-nickel steels with more than 7% nickel, and Cr + Ni = over 24 % This group is non-magnetic
Magnetic Properties	Can be hardened like ordinary steels	Cannot be hardened by heat treatment	Cannot be hardened by heat treatment
Heat Treatment	Tough—even in notched sections	Not very tough when notched	Extremely tough at all times
Toughness	Readily forged, pierced or rolled	Readily forged, pierced or rolled	Readily forged, pierced or rolled
Air Hardening Properties	Air harden from above 1500° F.	Do not air harden appreciably	Do not air harden at all
Cold Work Properties	Can be cold drawn or rolled, spun, formed, upset, coined or deep drawn	Can be cold drawn or rolled, spun, formed, upset, coined or deep drawn	Can be cold drawn or rolled, spun, formed, upset, coined or deep drawn
Machinability	Ordinary types—fair. Free-Machining types—excellent	Fair	Work hardens rapidly
Cold Riveting	Good	Good	Ordinary types—poor. Free-Machining types—good.
Hot Riveting	Must be driven below 1500° F.	Consult Mfr. for special precautions	Good—must be heated over 1800° F.
Welding	Can be welded with gas, arc or resistance. Weld air hardens.	Can be welded with gas, arc or resistance. Grain growth may result.	Easy to weld with gas, arc or resistance. See intergranular corrosion.
Grain Growth at High Temperature	No grain growth up to 1400° F.	Rapid grain growth and brittleness when used at elevated temperature	Grain growth starts at temperatures above 1800° F. Not brittle.
Strength at High Temperature	Better than carbon steel up to 1200° F.	Better than Group A.	Best steels available of this group.
Intergranular Corrosion	Does not occur	Does not occur	Occurs when heated between 800°/1300° F.
Scale Resistance	Recommended up to 1200° F.	Increases with chromium content.	Better than Group B steels of same Cr.
Corrosion Resistance	OK in weather, water and some chemicals.	Better than Group A steels.	Better than Group B steels of same Cr.



## Relation of Time to Case Depth in Carburizing

The logarithmic chart above has been prepared from the data by R. W. Schlumpf, appearing in the 1939 edition of the Metals Handbook. The values for all practical purposes correspond with those given in Mr. Schlumpf's curves for the relation of time and temperature to carbon penetration, figures for his curves being taken from test runs in a production vertical, stationary type gas carburizer using natural gas (95-98% methane), S.A.E. steel 3115.

Quoting further from the handbook:

"In the gas carburizing process the factor of surface gas-metal equilibria can be more easily manipulated by varying the gas flow rate, introduction of diluents, interruption of gas flow, and variation of chamber pressure, than by varying the temperature, due to the effect of the latter on gaseous equilibria. In the  $\text{CH}_4 \rightleftharpoons \text{C} + 2\text{H}_2$  system the active carburizer ( $\text{CH}_4$ ) becomes less stable as the temperature increases while in the  $2\text{CO} \rightleftharpoons \text{C} + \text{CO}_2$  system the active carburizer ( $\text{CO}$ ) becomes more stable with increasing temperatures."



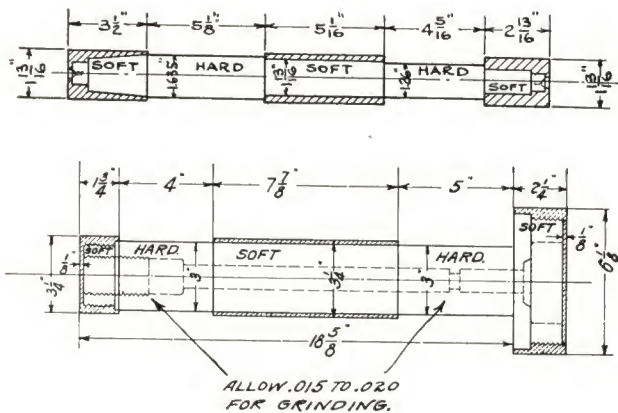
## Selective Carburization of Steels

To retain surface portions after hardening, for machinability, straightening or increased toughness, as on threads, selective carburizing is practiced.

While it can be carried out in various ways, such as (1) electroplating, either (1a) stopping off the electro deposit where carburizing is desired, or (1b) machining off the copper plate from those surfaces to be carburized after electroplating, (2) by using copper forms to protect certain areas as on shafts, tubes, etc., or (3) by using protective coatings, the most positive method of selective carburizing is (4) to provide excess stock at the surface portions which it is desired to keep soft.

Excess stock is left on the work as shown in the several accompanying illustrations, and after carburizing the work is slow cooled. The excess stock is then machined off below the case which will remain soft after the hardening treatment.

This method is especially applicable and reliable where threads or sharp corners are to be left soft.







## Hardness and Tensile Conversion Table

Approximate relations of hardness and tensile for SAE carbon and alloy constructional steels.

BRINELL		ROCKWELL		Shore Sclero-scope No.	Tensile Strength 1000 PSI.
Dia. in mm., 3000 kg. load 10 mm. ball	Hardness No.	C 150 kg. load 120° Diamond Cone	B 100 kg. load 1/16 in. dia. ball		
2.20	780	70	...	106	384
2.25	745	68	...	100	368
2.30	712	66	...	95	352
2.35	682	64	...	91	337
2.40	653	62	...	87	324
2.45	627	60	...	84	311
2.50	601	58	...	81	298
2.55	578	57	...	78	287
2.60	555	55	120	75	276
2.65	534	53	119	72	266
2.70	514	52	119	70	256
2.75	495	50	117	67	247
2.80	477	49	117	65	238
2.85	461	47	116	63	229
2.90	444	46	115	61	220
2.95	429	45	115	59	212
3.00	415	44	114	57	204
3.05	401	42	113	55	196
3.10	388	41	112	54	189
3.15	375	40	112	52	182
3.20	363	38	110	51	176
3.25	352	37	110	49	170
3.30	341	36	109	48	165
3.35	331	35	109	46	160
3.40	321	34	108	45	155
3.45	311	33	108	44	150
3.50	302	32	107	43	146
3.55	293	31	106	42	142
3.60	285	30	105	40	138
3.65	277	29	104	39	134
3.70	269	28	104	38	131
3.75	262	26	103	37	128
3.80	255	25	102	37	125
3.85	248	24	102	36	122
3.90	241	23	100	35	119
3.95	235	22	99	34	116
4.00	229	21	98	33	113
4.05	223	20	97	32	110
4.10	217	18	96	31	107
4.15	212	17	96	31	104
4.20	207	16	95	30	101
4.25	202	15	94	30	99
4.30	197	13	93	29	97
4.35	192	12	92	28	95
4.40	187	10	91	28	93
4.45	183	9	90	27	91
4.50	179	8	89	27	89
4.55	174	7	88	26	87
4.60	170	6	87	26	85
4.65	166	4	86	25	83
4.70	163	3	85	25	82

Figures in italics are an approximation and are to be used only as a guide.



# Temperature Conversion Table

For Temp. Scale Conversion

$$C^{\circ} = 5/9 (F^{\circ} - 32) \quad F^{\circ} = 9/5 C^{\circ} + 32$$

C	F	C	F	C	F
0	32	550	1022	1100	2012
10	50	560	1040	1110	2030
20	68	570	1058	1120	2048
30	86	580	1076	1130	2066
40	104	590	1094	1140	2084
50	122	600	1112	1150	2102
60	140	610	1130	1160	2120
70	158	620	1148	1170	2138
80	176	630	1166	1180	2156
90	194	640	1184	1190	2174
100	212	650	1202	1200	2192
110	230	660	1220	1210	2210
120	248	670	1238	1220	2228
130	266	680	1256	1230	2246
140	284	690	1274	1240	2264
150	302	700	1292	1250	2282
160	320	710	1310	1260	2300
170	338	720	1328	1270	2318
180	356	730	1346	1280	2336
190	374	740	1364	1290	2354
200	392	750	1382	1300	2372
210	410	760	1400	1310	2390
220	428	770	1418	1320	2408
230	446	780	1436	1330	2426
240	464	790	1454	1340	2444
250	482	800	1472	1350	2462
260	500	810	1490	1360	2480
270	518	820	1508	1370	2498
280	536	830	1526	1380	2516
290	554	840	1544	1390	2534
300	572	850	1562	1400	2552
310	590	860	1580	1410	2570
320	608	870	1598	1420	2588
330	626	880	1616	1430	2606
340	644	890	1634	1440	2624
350	662	900	1652	1450	2642
360	680	910	1670	1460	2660
370	698	920	1688	1470	2678
380	716	930	1706	1480	2696
390	734	940	1724	1490	2714
400	752	950	1742	1500	2732
410	770	960	1760	1510	2750
420	788	970	1778	1520	2768
430	806	980	1796	1530	2786
440	824	990	1814	1540	2804
450	842	1000	1832	1550	2822
460	860	1010	1850	1560	2840
470	878	1020	1868	1570	2858
480	896	1030	1886	1580	2876
490	914	1040	1904	1590	2894
500	932	1050	1922	1600	2912
510	950	1060	1940	1610	2930
520	968	1070	1958	1620	2948
530	986	1080	1976	1630	2966
540	1004	1090	1994	1640	2984
				1650	3002



## Capacity of Pipes, Air and Gas

Gas Capacity in Cu. Ft. Hr. of Pipe of Different Diameters and Different Lengths. Spec. Gr. .6—Pressure Drop .2".

SIZE OF PIPE

Length of Pipe, Feet	$\frac{3}{4}$ "	1"	$1\frac{1}{4}$ "	$1\frac{1}{2}$ "	2"	3"	4"
15	168	350	620	960	2000	5400	11200
30	120	245	430	680	1400	3800	7900
45	98	200	355	530	1150	3200	6500
60	84	175	310	480	1000	2700	5600
75	76	155	275	430	890	2450	5000
90	70	145	250	395	810	2260	4550
105	64	132	232	370	750	2100	4200
120	60	125	215	340	700	1950	4000
150	54	110	195	310	630	1750	3550
180	49	100	175	280	570	1600	3200
210	44	94	165	260	530	1450	3000
240	43	88	155	240	500	1350	2800
270	40	83	145	230	470	1300	2650
300	38	79	138	215	440	1250	2500
450	31	64	112	176	360	1000	2050
600	27	56	97	152	315	860	1750

Air Capacity in C. F. M. of Various Dia. Pipes and Various Lengths. Pressure Drop  $3''$  Water Column.

SIZE OF PIPE

Length in Feet	1"	$1\frac{1}{4}$ "	$1\frac{1}{2}$ "	2"	$2\frac{1}{2}$ "	3"	4"
60	7.5	15	23	43	66	125	260
80	6.5	13	20	37	60	109	226
100	6	12	19	34	56	100	208
125	5.5	11	17	31	50	90	187
150	5	10	15	28	46	82	170
175	4.5	9.3	14	26	42	75	156
200	4.3	8.6	12	24	40	70	145
300	3.4	7	11	20	32	57	117
400	2.9	6.1	9.3	17	28	49	101
500	2.6	5.4	8.3	15	25	44	90
600	2.3	4.9	7.3	14	23	39	81

Length in Feet of Standard Pipe to Allow for Various Screw Fittings.

Pipe Size	Gate Valve	Long Ell or Run of Tee	Red'g. Coup. $\frac{1}{4}$ " Red'n.	Std. Ell or $\frac{1}{2}$ " Red'n.	Tee Through Side Outlet	Globe Valve
$\frac{1}{2}$	.031	.41	.52	.84	1.66	2.5
$\frac{3}{4}$	.044	.57	.73	1.17	2.33	3.5
1	.057	.77	.98	1.57	3.11	4.68
$1\frac{1}{4}$	.082	1.07	1.37	2.19	4.35	6.54
$1\frac{1}{2}$	.098	1.29	1.64	2.63	5.21	7.84
2	1.320	1.74	2.23	3.55	7.05	10.6
3	2.130	2.81	3.59	5.72	11.4	17.08





## Data on Various Materials

Material	Sp. Gr.	Wt. per Cu. In. Lbs.	Melting Point °F.	Spec. Heat Approx.
Aluminum	2.6	.095	1225	.23
Brass	8.4	.303	1700	.095
Bronze	8.8	.32	1675	.09
Copper	8.9	.32	1980	.1
Cast Iron	7.2	.26	2300	.15
Lead	11.4	.41	620	.031
Steel	7.8	.28	2500	.117
Tin	7.3	.26	450	.054
Zinc	7.1	.26	785	.1
Gold	19.3	.70	1945	.032
Silver	10.5	.38	1761	.057
Fire Clay	1.9	.069	3000	.3
Glass	2.6	.094	1200	.194
Oil	.8	.028		.4
Insulating Refractory (Med. Grade)	.97	.035	2600	.2

(Note: These figures are approximate only and are not intended for very exact calculations.)

## Conversion Factors

1 Atmosphere = 760 mm. Mercury	1 Joule = .738 foot pounds
1 Atmosphere = 14.7 lbs. per sq. in.	1 Joule = .000239 calories
1 B. t. u. = .252 Large Calories	1 Kilogram = 2.205 pounds
1 B. t. u. = 778 Foot Pounds	1 Kilo. per sq. Cm. = 14.22 lbs.
1 B. t. u. = .298 Watt Hours	per sq. in.
1 B. t. u. per cu. ft. = 8.90 Calories	1 Kilo. per sq. Meter = .205 lbs.
(large) per cu. meter	per sq. ft.
1 B. t. u. per pound = 556 Calories	1 Kilometer = .6214 miles
per kilogram	1 Kilowatt = .949 B. t. u. per sec.
1 Calorie (large) = 3.97 B. t. u.	1 Kilowatt = .239 Calories per sec.
1 Calorie (large) = 4180 Joules	1 Kilowatt = 738 ft. lbs. per sec.
1 Centimeter = .394 Inches	1 Kilowatt = 1.341 Horsepower
1 Cu. Centimeter = .0610 cu. inches	1 Litre = .0353 cu. ft.
1 Cu. Foot = .0283 cu. meters	1 Litre = .220 gallons
1 Cu. Foot = 7.48 gallons	1 Meter = 3.281 feet
1 Cu. Inch = 16.4 cu. centimeters	1 Meter = 39.37 inches
1 Cu. Meter = 35.3 cu. feet	1 Meter = 1.094 yards
1 Cu. Meter = 1.307 cu. yards	1 Mile = 1.609 Kilometers
1 Cu. Yard = .765 cu. meters	1 Mile per Hr. = 1.467 ft. per sec.
1 Foot = .3048 meters	1 Millimeter = .03937 inches
1 Foot Pounds = 1.356 Joules	1 Ounce (avoir.) = 28.35 grams
1 Foot Pound = .00129 B. t. u.	1 Ounce (troy) = 31.09 grams
1 Gallon = 4.546 litres	1 Pound (avoir.) = .454 Kilograms
1 Gallon = .134 cu. feet	1 Lb. per Sq. Ft. = 4.88 Kilos per
1 Grain = .0648 grams	sq. Meter
1 Gram = 15.44 grains	1 Quart = 1.136 litres
1 Gram = .002205 pounds avoir.	1 Radian = 57.3 degrees
1 Horsepower = .707 B. t. u. per Sec.	1 Sq. Cm. = .155 sq. in.
1 Horsepower = .178 Calories per	1 Sq. In. = 6.45 sq. cm.
Sec.	1 Sq. Ft. = .093 sq. meters
1 Horsepower = .746 Kilowatts	1 Sq. Meter = 10.76 sq. ft.
1 Inch = 2.54 centimeters	1 Sq. Meter = 1.196 sq. yds.
1 Inch Mercury = 13.6" water	1 Ton (2000 Lbs.) = 1015.6 kilos
1 Inch Mercury = .490 lb. per sq. in.	1 Watt Hour = 3.415 B. t. u.
1 Inch Water = .0735 in. mercury	1 Yard = .9144 meters.
1 Inch Water = .0360 lb. per sq. in.	

EQUIVALENT COST OF GAS AT VARIOUS EFFICIENCIES VS. ELECTRICAL ENERGY AT 100% EFFICIENCY

APPROX. 600° F.			APPROX. 1200° F.			APPROX. 1600° F.			APPROX. 2200° F.		
Elec. Cost Per KWH 100% Eff.	Gas Cost Per Therm. 80% Eff.		Elec. Cost Per KWH 100% Eff.	Gas Cost Per Therm. 65% Eff.		Elec. Cost Per KWH 100% Eff.	Gas Cost Per Therm. 55% Eff.		Elec. Cost Per KWH 100% Eff.	Gas Cost Per Therm. 45% Eff.	
\$0.0026	\$0.06		\$0.0032	\$0.06		\$0.0037	\$0.06		\$0.0046	\$0.06	
.0030	.07		.0037	.07		.0043	.07		.0053	.07	
.0034	.08		.0042	.08		.0050	.08		.0061	.08	
.0038	.09		.0047	.09		.0056	.09		.0068	.09	
.0043	.10		.0053	.10		.0062	.10		.0076	.10	
.0047	.11		.0058	.11		.0068	.11		.0084	.11	
.0051	.12		.0063	.12		.0075	.12		.0091	.12	
.0056	.13		.0068	.13		.0081	.13		.0099	.13	
.0060	.14		.0074	.14		.0087	.14		.0106	.14	
.0064	.15		.0079	.15		.0093	.15		.0114	.15	
.0068	.16		.0084	.16		.0100	.16		.0122	.16	
.0073	.17		.0089	.17		.0106	.17		.0129	.17	

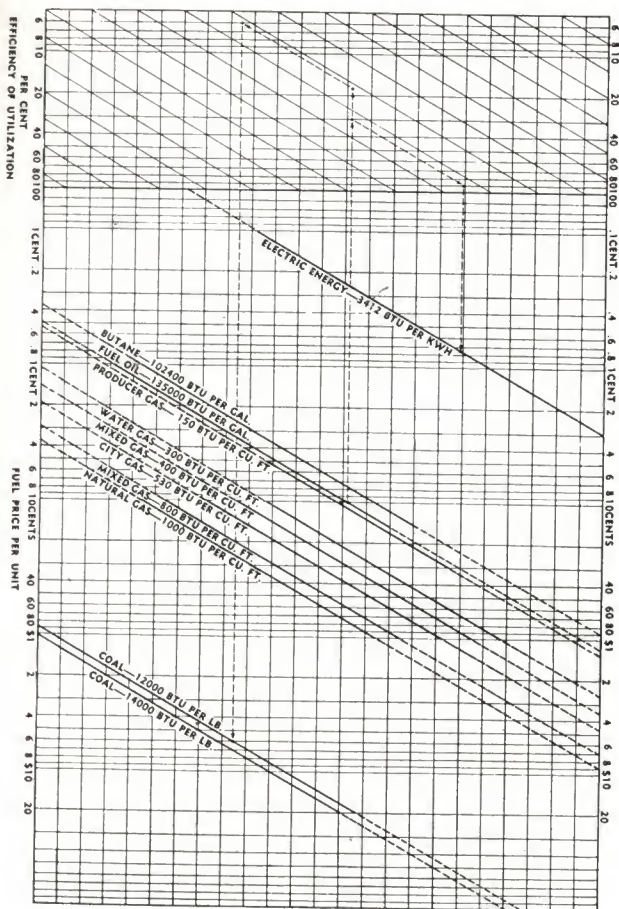
Explanation—At various temperatures, gas efficiencies change because of heat lost in the flue products—see separate tabulation of "available heat." For example, if one intends to work at about 1600°, gas efficiency can only be 55% with usual means. At this efficiency, if one can buy gas for 10¢ per therm (100,000 BTU), to equal the cost in electricity, one would need a rate as low as 6/10 cents per KWH.

AVAILABLE HEAT IN GAS AT VARIOUS TEMPERATURES;—BASED ON 1000-1060 BTU NATURAL GAS

Temp.	Av. BTU	% Eff.	Temp.	Av. BTU	% Eff.	Temp.	Av. BTU	% Eff.
600°F	820	78	1200°F	690	65	1800°F	540	51
700°	800	76	1300°	670	64	1900°	515	49
800°	775	74	1400°	640	61	2000°	500	48
900°	750	71	1500°	610	58	2100°	480	46
1000°	730	70	1600°	590	56	2200°	450	43
1100°	710	68	1700°	570	54	2300°	420	40



## CHART OF COMPARATIVE FUEL PRICES



### Unit Prices.

Gases, Cents per 1000 cu. ft.  
Oil and Butane, cents Per gal.

Electric energy, cents Per KWH.  
Coal, Dollars per ton (2000 lbs.)

### ILLUSTRATIVE USE OF CHART

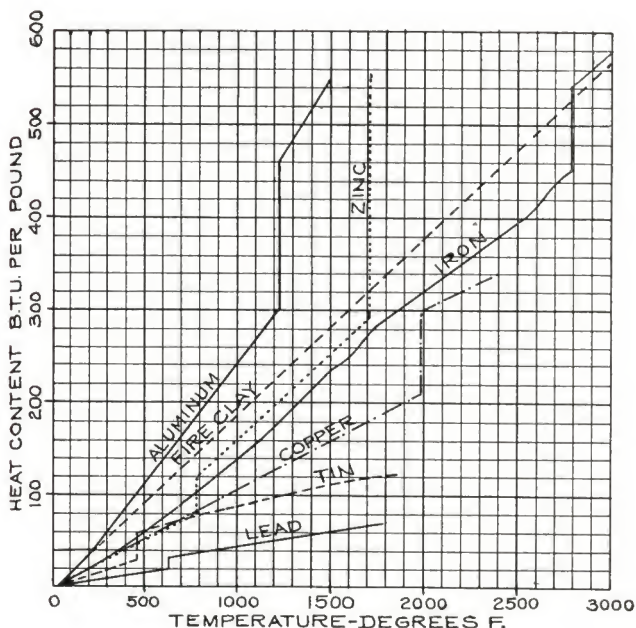
To find the equivalent cost of electric energy at 90% efficiency compared with fuel oil at 10c per gal. and 30% efficiency. From the intersection of the Price line and the fuel line follow left to the oil efficiency (30%) then follow the diagonal guide lines to the efficiency of the electric energy (90%) from there follow the horizontal guide lines to the intersection of the line for electric energy reading the equivalent price (.75c), on the top or bottom scale.

Courtesy of W. S. Rockwell Co.





## HEAT CONTENT OF VARIOUS METALS



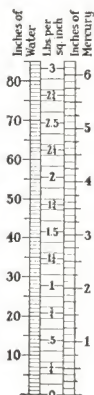
### Heat Colors

Faint Red.....	930° F.
Blood Red.....	1075° F.
Dark Cherry.....	1175° F.
Medium Cherry.....	1275° F.
Cherry.....	1375° F.
Bright Cherry.....	1450° F.
Salmon.....	1550° F.
Dark Orange.....	1634° F.
Orange.....	1725° F.
Lemon.....	1830° F.
Light Yellow.....	1975° F.
White.....	2200° F.
Bluish White.....	2350° F.

### Temper Colors

Lemon Yellow.....	430° F.
Light Straw.....	458° F.
Dark Straw.....	478° F.
Purple (Reddish).....	523° F.
Purple (Bluish).....	551° F.
Blue.....	572° F.
Gray Blue.....	603° F.
Greenish Blue.....	627° F.
Gray.....	700° F.

Pressure Conversion Chart→





## Table of Circles that Can be Inscribed within an Enclosing Circle

From the table below the number of circles of a given diameter that can be inscribed in a larger circle of known diameter, can be found.

$N$  = number of inscribed circles.

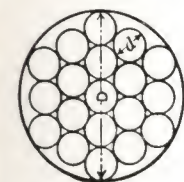
$$R = \text{ratio} = \frac{\text{diameter of large circle}}{\text{diameter of small circle}} = \frac{D}{d}$$

Examples: How many wires,  $\frac{1}{2}$  inch in diameter, can be placed inside a pipe, 5 inches in diameter?  $R = 5 \div \frac{1}{2} = 10$ , and finding the value nearest to this number in the columns of  $R$  in the table,  $N=76$  is determined by interpolation.

Approximate Formulas:

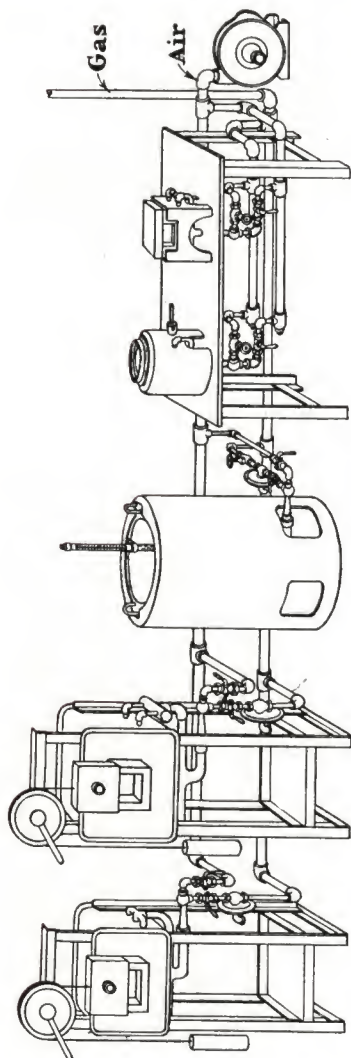
$$N = 0.907 \left( \frac{D}{d} - 0.94 \right)^2 + 3.7$$

$$R = 0.94 + \sqrt{\frac{N-3.7}{0.907}}$$



$N$	$R$	$N$	$R$	$N$	$R$	$N$	$R$	$N$	$R$
2	2.00	34	6.76	130	12.80	290	18.75	600	26.65
3	2.15	35	6.86	135	13.06	295	18.90	610	26.86
4	2.41	36	7.00	140	13.26	300	19.05	620	27.07
5	2.70	37	7.00	145	13.49	310	19.35	630	27.28
6	3.00	38	7.08	150	13.72	320	19.65	640	27.49
7	3.00	39	7.18	155	13.95	330	19.94	650	27.70
8	3.31	40	7.31	160	14.17	340	20.23	660	27.91
9	3.61	41	7.39	165	14.39	350	20.52	670	28.12
10	3.80	42	7.43	170	14.60	360	20.81	680	28.33
11	3.92	43	7.61	175	14.81	370	21.09	690	28.74
12	4.05	44	7.70	180	15.01	380	21.36	700	28.75
13	4.23	45	7.72	185	15.20	390	21.63	720	29.14
14	4.41	46	7.81	190	15.39	400	21.90	740	29.52
15	4.55	47	7.92	195	15.57	410	22.17	760	29.90
16	4.70	48	8.00	200	15.75	420	22.44	780	30.28
17	4.86	49	8.03	205	15.93	430	22.70	800	30.65
18	5.00	50	8.13	210	16.11	440	22.96	820	31.02
19	5.00	55	8.21	215	16.29	450	23.21	840	31.39
20	5.18	60	8.94	220	16.46	460	23.47	860	31.75
21	5.31	65	9.25	225	16.63	470	23.72	880	32.11
22	5.49	70	9.61	230	16.80	480	23.97	900	32.46
23	5.61	75	9.93	235	16.97	490	24.21	920	32.80
24	5.72	80	10.20	240	17.14	500	24.45	940	33.14
25	5.81	85	10.46	245	17.30	510	24.68	960	33.48
26	5.92	90	10.73	250	17.46	520	24.91	980	33.82
27	6.00	95	11.15	255	17.63	530	25.13	1000	34.15
28	6.13	100	11.34	260	17.79	540	25.35	1100	35.75
29	6.23	105	11.60	265	17.95	550	25.57	1200	37.30
30	6.40	110	11.85	270	18.11	560	25.79	1300	38.80
31	6.44	115	12.10	275	18.27	570	26.01	1400	40.20
32	6.55	120	12.34	280	18.43	580	26.23	1500	41.60
33	6.70	125	12.57	285	18.59	590	26.44	1600	42.95

Courtesy of Machinery Handbook



Small Tool Room Heat Treating Department

A few suggestions may be in order to the man who is installing a small heat treating department.

1. The gas and air lines should be of ample size so that additional equipment can be installed later if desired.
2. The number of elbows and bends in these lines should be kept at a minimum to reduce friction losses.
3. Plenty of outlets should be provided in these lines in addition to those necessary for the equipment to be installed so that additional equipment can be later installed or changes made with a minimum amount of trouble.
4. The gas line should be painted red; the air line may be painted any other color, as for example, green or blue for ready identification.
5. Sufficient space should be left around the furnaces for convenience in cleaning up, repairing, etc. If they are lined up against the wall, 12" to 15" should be allowed between them and the wall.
6. A concrete floor for the furnace is preferable although not absolutely necessary.
7. The bench or table on which furnaces are mounted may be of wood or steel; however, it should be provided with a sheet steel top. It is usually preferable that this bench be about 30" high so that the furnaces are at the most convenient height for operation.
8. Placing the furnaces in a line so that they can be served from main air and gas lines is usually preferable. If wall space is not available, a double row of furnaces arranged back to back makes a good layout.





## Suggestions for Auxiliary Equipment

1. **Quenching Tanks** are essential and we would suggest at least three of them which may be from 18" to 24" in diameter by about 24" deep.

Suitable tanks can be obtained from practically any hardware store. If not, a sheet metal worker or plumber can make them.

It is usually desired to use one tank each for quenching oil, water and brine. Mesh wire baskets for these tanks facilitate recovery of the pieces in case they are dropped.

2. **Indicating Pyrometers.** For accurate hardening, temperature indicating instruments are essential.

3. **Annealing Box.** For slow cooling (annealing), a box, preferably of metal a foot to a foot and a half square by 8" to 10" deep filled with lime, should be available.

4. **Vise.** A sturdy vise mounted on the work bench is convenient for bending and forming parts. If it is used for breaking samples, every precaution should be taken that the end which is broken off and chips do not injure anyone in the vicinity. A box especially fitted for breaking samples is preferable.

5. **Carburizing Boxes.** Several small carburizing boxes with covers, preferably of heat-resisting alloy, should be available for carburizing, pack annealing, etc.. These boxes usually need not exceed about 6" x 8" x 2½" deep. If boxes with short legs or lugs to serve as legs are used, more rapid and uniform heating of them and their contents is obtained because the heat will penetrate from the bottom as well as the top and sides.

6. **Thermometer for Quenching Oil.** Especially in hardening light springs, etc., the quenching oil should be hot if distortion and warping is to be held to a minimum. A mercury thermometer permits checking the temperature of the coolant.

7. **Blowpipe.** A No. 1 Hand Blowpipe at the work bench is convenient for local annealing and tempering and for many other requirements too numerous to mention.

8. **Tongs.** A complete set of straight and angle tongs of light weight are essential. If heavy tongs are used for handling light work the work is cooled at the places where the tongs contact and ununiform quenching with unsatisfactory hardness results.

9. **Spare Pots.** Spare pots for both the Oil Tempering Furnace and the Lead Hardening Furnace are recommended so that if desired salt may be used as the tempering medium, and the Lead Hardening Furnace may be used for salt bath hardening, cyanide casehardening, etc.

10. **Files.** Several coarse files and/or a block of emery or carborundum should be provided for polishing chisels, etc., to observe the temper colors when such work is tempered after hardening.

1. **Anvil.** A small anvil is essential for forging work.

12. **Fire Clay.** A small supply of our Machlet Furnace Cement should be available at all times for patching and repair work, also for use on special jobs. It is quite effective for stopping off the case when it is desired to locally carburize.

13. **Torch.** For lighting furnaces, a torch may be readily made from a piece of stiff wire, one end of which is coiled about a piece of asbestos. A torch fifteen to eighteen inches in length is ample for small furnaces. This torch should be dipped in oil and may then be lighted with a match.

**PRECAUTIONS.** If by any chance a saltpeter (potassium nitrate) bath is provided for blackening, extreme care must be taken that cyanide does not come in contact with it when hot as an explosion will occur.

Be certain that all work is absolutely dry before placing it in a cyanide, salt or lead bath as violent spattering will occur and the operator may be seriously burned.



## Furnace Lighting Instructions

(Air-Gas System)

OUR equipment is usually supplied to use air at approximately one pound pressure which is passed through the Venturi Mixer entraining the proper amount of gas. A Zero Governor may or may not be used to provide one valve regulation.

In general, the following steps should be observed when lighting furnaces:

1. Open all doors and observation holes.
2. Keeping gas valve shut, open air cock wide for two minutes or more to purge the chamber completely.
3. Close down air cock until one-quarter or one-half open. If furnace is equipped with manifold pressure gauge, air should be turned down to a pressure of  $1\frac{1}{2}$ " water column for city gas and approximately  $\frac{3}{4}$ " for natural, bottled, or other slow burning gases.
4. Insert lighting torch in front of burners and turn on gas until ignition takes place. Adjust gas valve for proper combustion.
5. If using rapid burning gases, such as city gas, maximum input may now be set as desired. If using natural or slow burning gases, first allow burner tunnels to become thoroughly heated, otherwise flame will blow off the burner.

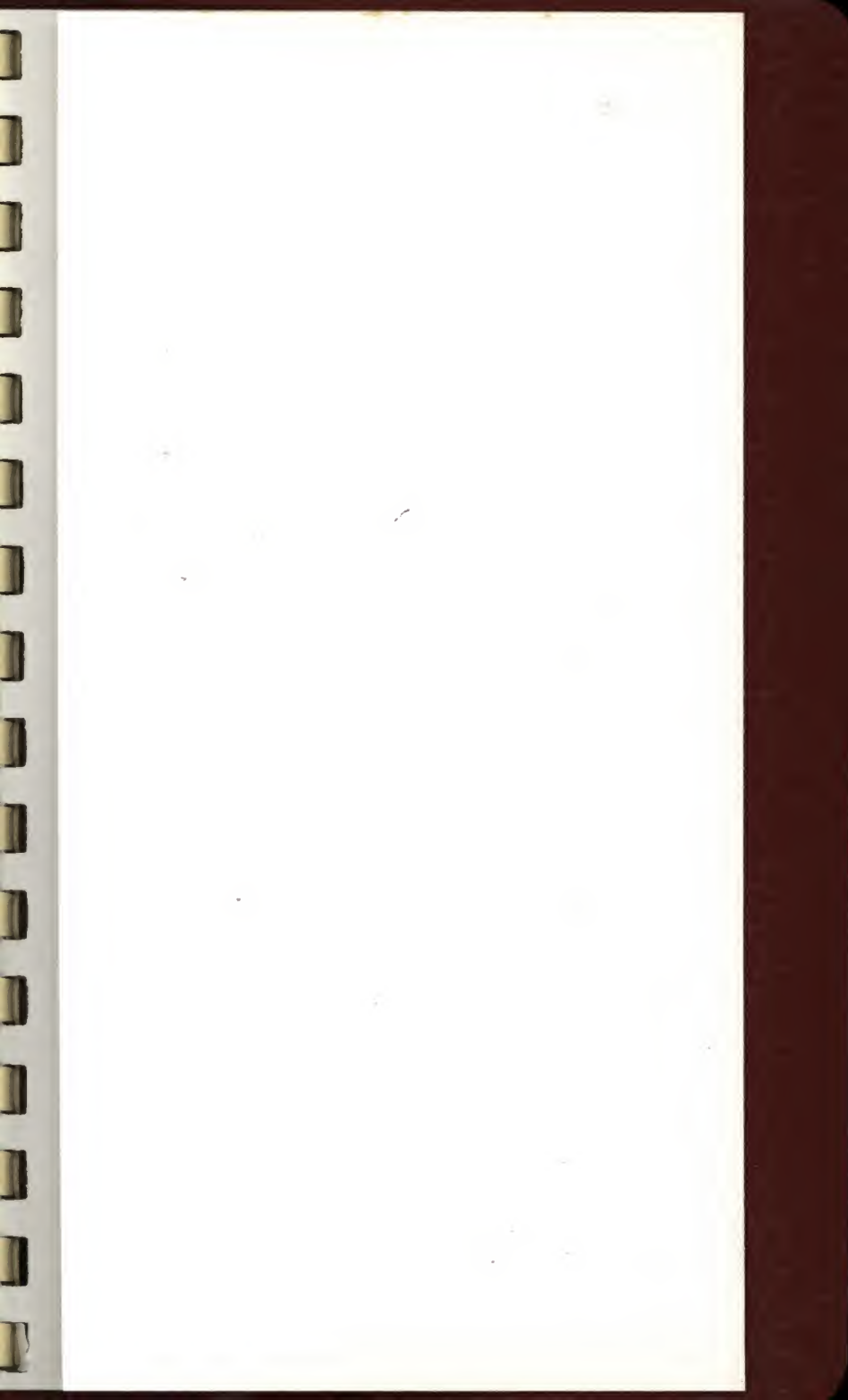
### RULE OF THUMB

When lighting open air cock first.

When shutting-off close gas valve first.

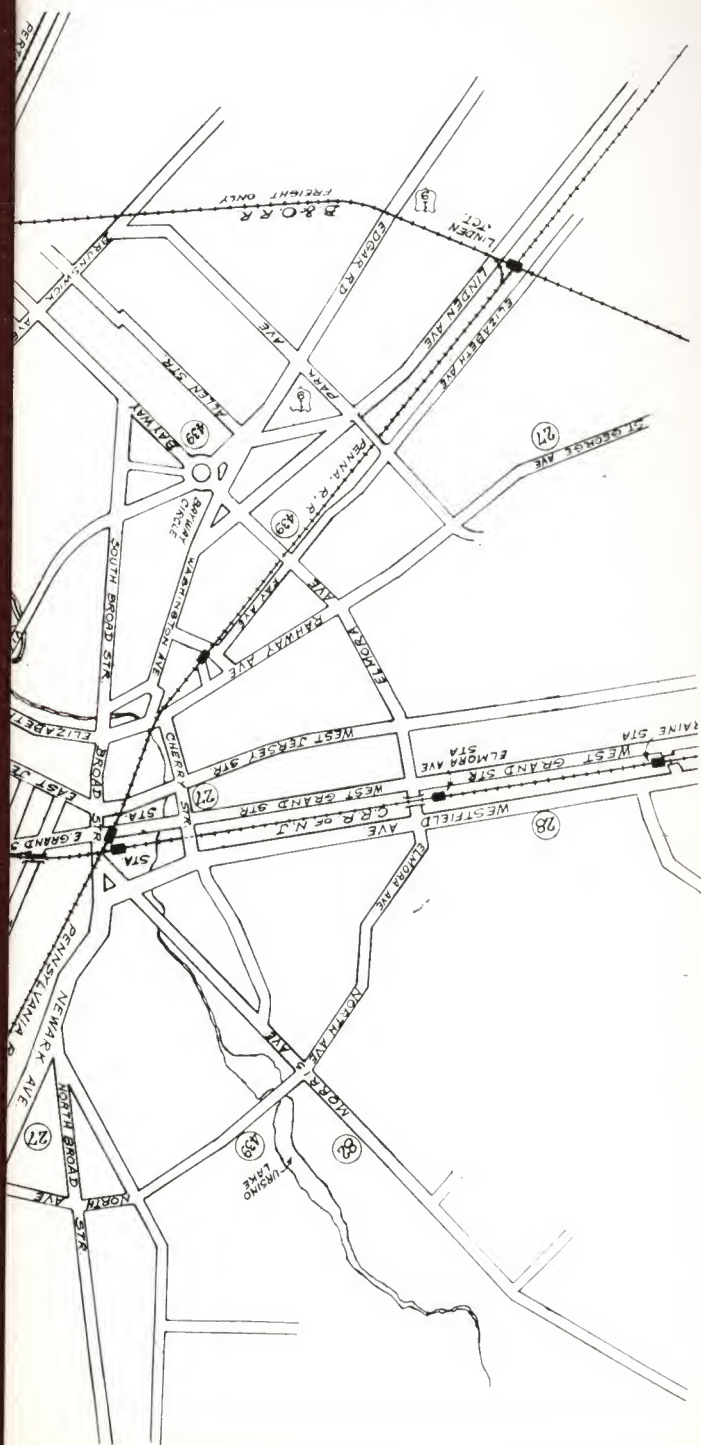
### PRECAUTION

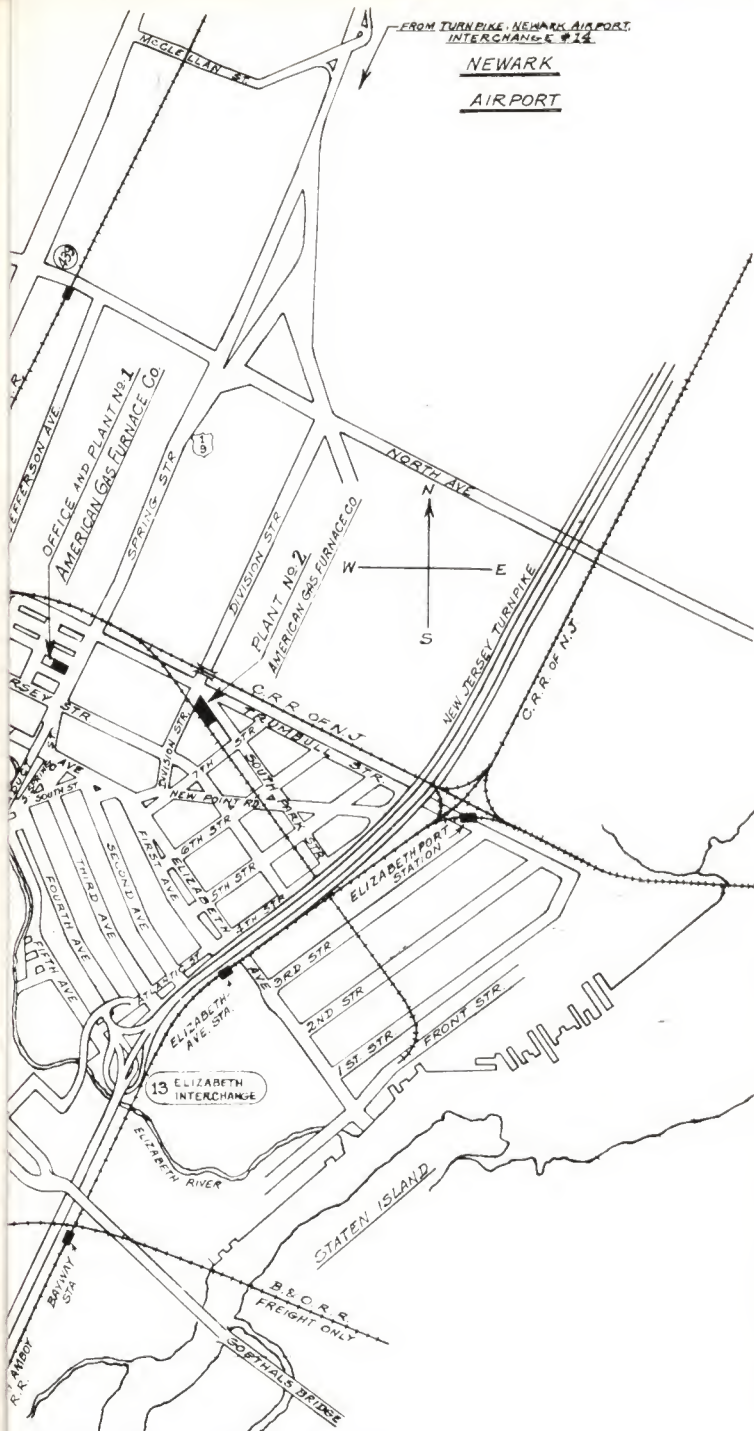
When first lighting up new furnaces, especially ones containing alloy parts, special care should be taken to heat up very slowly. This will prevent undue strains from being set up and will give longer life to the parts. Manifold pressure during operation should never fall below  $\frac{1}{2}$ " to  $\frac{3}{4}$ " water column, else back-firing will result.





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